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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

THE AKALA BERRY OF HAWAII . . . . . J. F. ROCK

A NEW TANGELO . . . . . SWINGLE AND ROBINSON

THE PEJIBAYE, A TROPICAL FOOD-PLANT POPENOE AND JIMINEZ

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VISIBLE RECORDS OF HEREDITY. . . . DAVID FAIRCHILD

DATURA—AN INVITING STUDY OF HEREDITY . . W. E. SAFFORD

PUBLISHED MONTHLY AT MENASHA, WISCONSIN

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WASHINGTON, D. C.

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The American Genetic Association

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Date of issue of this number, August 30, 1921.

THE AKALA, A GIANT RASPBERRY FROM THE HIGHEST MOUNTAIN OF THE PACIFIC

This remarkable raspberry, which sometimes attains two inches in diameter, was discovered many years ago by the U. S. Exploring Expedition, but living material and photographs of its largest forms have just been secured for the plant breeders of the world. There are two wild varieties already differing in color, flavor, and degrees of spininess. (Frontispiece.)

THE AKALA BERRY OF HAWAII

Asa Gray's Rubus Macraei, an Endemic Hawaiian Raspberry

J. F. Rock

Agricultural Explorer, Office of Foreign Seed and Plant Introduction
Bureau of Plant Industry, U. S. Department of Agriculture

THE native Akala of Hawaii (*Rubus Macraei*, Gray) was first discovered by the U. S. Exploring Expedition on the slopes of Mauna Kea, the highest mountain of the Pacific, at an elevation of 6,000 feet. The species was described by Asa Gray in the Botany of that Expedition and was figured in plate 57 accompanying the atlas.

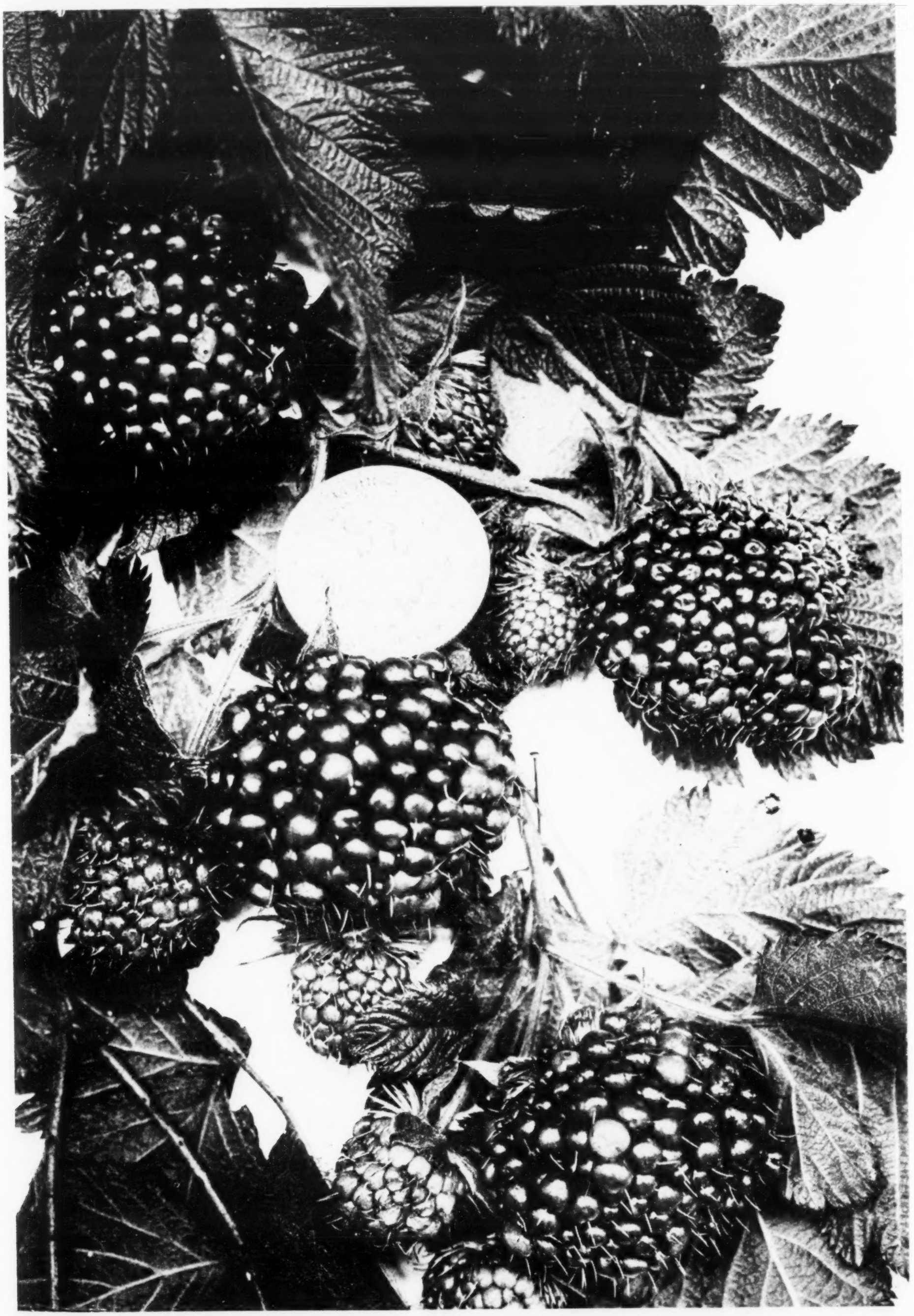
No mention is made regarding its horticultural possibilities until the time of Hillebrand, who in his Flora of Hawaii on page 116 says, in a footnote: "The species can be recommended for cultivation." It may be stated at the outset that *Rubus Macraei* is a most variable species and after a close examination of herbarium material and field work it will have to be divided into several varieties if not actual species.

The Akala berry occurs on several islands of the group, as for example Kauai, Molokai, Maui and Hawaii. On Kauai it is an upright spineless shrub only a few feet in height, with rather small, dry berries. This type was placed by Hillebrand under *Rubus Hawaiiensis*, with which it has little relationship, being of an entirely different habit. It seems that Hillebrand confused both species considerably; and the Hawaiian species of Rubus represent another case of confusion such as has been found to exist in the species of *Pritchardia*, a genus of palms. On Maui the plants resemble, somewhat, the typical species from Hawaii, the type locality, but the plants are exceedingly spiny and the fruits not half the size of those found on Hawaii. It is from the Maui species, especially those coming from the much frequented slopes of Haleakala, that seeds were usually collected and sent to experimenters. *Rubus Macraei* finds its best development on the slopes of the high mountains of Hawaii proper—on Hualalai, Mauna Loa and Mauna Kea. The largest fruited specimens ever discovered by me were in a little oasis, a small volcanic cone of greater age than the country surrounding it. This cone, known as Hinakapanula, is located at 6,000 feet elevation in an absolute desert lava field resembling very much the famous "sand see" of Mr. Brown's Java. There was no vegetation to be found in this cinder plain, but the cone was one mass of jungle—it having escaped the destructive lava flows. The plants were mainly *Acacia koa hawaiiansis*, *Coprosma pubens*, *Styphelia tameiameiae* and *Rubus macraei*. Here *Rubus macraei* was not an upright shrub or bush but in reality a huge liana some 20 feet in length with a woody stem two inches in diameter. The berries were of a dark rich purple and at least two inches in diameter. A remarkable feature of the plants was the total absence of spines.

In the fern forests near the volcano of Kilauea there occurs another form of *Rubus macraei* which is also spineless, at least in older plants. This region has been given over to cattle grazing and consequently *Rubus macraei* has disappeared as a terrestrial plant and has only escaped total destruction there by becoming epiphytic. All the plants found there grow in the forks of moss-covered trees, or fallen monarchs of *Acacia koa hawaiiensis*. This would indicate that if it does require an acid soil it is at least not averse to such conditions. To be sure the berries are not as large as those found on Hualalai or Mauna Kea Islands, but still are over an inch and a half in diameter, and

THE AKALA BERRY BUSHES ON THE SLOPES OF MAUNA KEA

This giant raspberry covers many acres of ground at an altitude of 6,000 feet in a forest of Koa trees where it crowds out everything else. The climate is cool at this altitude; frosts are not uncommon, and the bushes are enshrouded with fog for the greater part of the day. This giant raspberry from Mauna Kea, Hawaii, together with the Giant Blackberry from Fusagusaga, Colombia (described in the JOURNAL, Vol. XI, No. 5) are good examples of the wild plants which are waiting to be used by the plant breeders in the making of superior varieties of cultivated fruits for our gardens. Even though we cannot match the cool, moist climates of the regions in which these two remarkable species occur, we should certainly be able to grow and flower them and use the pollen in the building of new races of blackberries and raspberries. (Fig. 1.)



A CLUSTER OF AKALA BERRIES ACTUAL SIZE

For comparison, a silver half-dollar is inserted. These were not the largest fruits collected; exceptional fruits measured two inches across and were as large as a silver dollar. They are juicy, with small seeds, and vary in flavor, some having a slightly bitter taste, while others are very delicious. There is a dark purple and an orange yellow variety, the former borne by almost spineless plants, the other on spiney bushes. Authentic specimens of both these varieties are now in the collection of the Office of Foreign Seed and Plant Introduction of the Department of Agriculture in Washington. (Fig. 2.)

this with a minimum of humus and an absence of real soil.

On my return from the Orient I decided to stop over in Hawaii for the purpose of securing seeds and root shoots of this remarkable species for the plant breeders to experiment with.

I went to the type locality on the slopes of Mauna Kea, in company with Mr. Kraebel, Assistant Superintendent of Forestry, together with my friend and traveling companion, Mr. S. Jurgens. We found *Rubus macraei* covering many acres of ground in a forest of Koa trees, forming the undergrowth to the exclusion of everything else. Here at 6,000 feet elevation on the windward slopes of Mauna Kea the atmosphere is always cool and the nights even cold, frost being not uncommon in the winter. After eleven o'clock clouds invaribly ascend from the sea and the slopes of the mountain at this elevation is invariably enshrouded in fog for the greater part of the day.

Rubus macraei grows here as a terrestrial upright, but does not become a liana as is the case in Hualalai. It is a most prolific bearer and the buds of the whip-like branches bend under the weight of the luscious, heavy fruits.

We found here two distinct varieties —one dark purple and one a bright orange-yellow. One of these yellow fruits exceeded in size even the largest of the purple fruited variety; it was in fact larger than a silver dollar, being two inches in diameter. This yellow variety was, however, quite spiny, while the purple one was almost spineless, only the young shoots being armed.

The juiciness of these fruits is remarkable—a fact which might prove a disadvantage as it will probably make the berry a poor shipper. The seeds are quite small and all the rest is juice. The dark variety is slightly bitter, while the yellow variety is quite sweet and really delicious. Hybridization may work wonders with this species and its distinct varieties. It would be best adapted, in the United States, to a locality with mild winters and fogs; I suppose on the Pacific slope wherever the redwood occurs would fill the requirement.

I am indebted to my friend, Mr. A. McAllester of Kukaian Ranch, Mauna Kea, through whose kind hospitality and courtesy, the furnishing of horses, etc., I was enabled to secure valuable living material which is being propagated for distribution to experimenters.

RACE AND NATIVITY OF FARMERS IN THE UNITED STATES

According to a report of the Fourteenth (1920) Census recently issued, of the 6,448,366 farmers in the United States in 1920, 5,498,359 were white and 950,007 were colored, while in 1910, out of a total of 6,361,502 farmers, 5,440,619 were white and 920,883 were colored. White farmers thus represented 85.3 per cent of all farmers in 1920, as compared with 85.5 per cent, or practically the same proportion, in 1910.

Between 1910 and 1920 the number of white farmers increased 57,740, or 1.1 per cent, and the number of colored farmers, 29,124, or 3.2 per cent.

The 950,007 colored farmers in 1920 comprised 926,257 Negroes, 16,213 Indians, 6,899 Japanese, and 638 Chinese. The corresponding figures for 1910 were 893,370 Negroes, 24,251 Indians, 2,502 Japanese, and 760 Chinese. The following table gives the figures in convenient form.

(The number of farmers is assumed to be the same as the number of farms.)

	Number	Per cent of total
All farmers:		
1920	6,448,366	100.0
1910	6,361,502	100.0
White farmers, total:		
1920	5,498,359	85.3
1910	5,440,619	85.5
Native white farmers:		
1920	4,917,305	76.3
1910	4,771,063	75.0
Foreign-born white farmers:		
1920	581,054	9.0
1910	669,556	10.5
Colored farmers:		
1920	950,007	14.7
1910	920,883	14.5

A NEW TANGELO

The Origin of a Pink-Fleshed Citrus Fruit by Hybridization

WALTER T. SWINGLE AND T. RALPH ROBINSON
Bureau of Plant Industry, U. S. Department of Agriculture

AMONG the fruit crosses made at Eustis, Florida, in 1908 was one in which pollen of the Sampson Tangelo[1] was used to pollinate flowers of a seedling grapefruit of good quality. This cross was made by Mr. F. W. Savage, plant breeder, acting under the direction of the senior author.

From the grapefruit resulting from this cross, sixty seeds were obtained. Two of the resulting seedlings have fruited out at Eustis showing hybrid character with no points of especial promise. To distinguish this hybrid from the first cross of tangerine and grapefruit, the combination is designated a "tangelolo" (from "tangelo" and pomelo), but popularly this fruit should be classed with the tangelos. The freeze of 1917 destroyed most of the original seedlings and buds of this hybrid at Eustis, but one bud (Crop Physiology and Breeding No. 47,220) which was inserted in March 1914 on an old sour orange tree, and which survived, bore fruit during the season of 1918. The first fruits were picked November 6 and sent in to Washingotn for examination. About four dozen fruits were borne on one branch the first season, four years from time of budding.

In general appearance, size, shape and character of rind, the fruits resemble the pollen parent (the Sampson tangelo) but on cutting the fruit, it appears to be a rather remarkable hybrid. The color of the pulp, or rather of the lining membrane and partition walls, is a reddish pink (Ridgeway, Peach Red, Plate I b 5,00–R, in some fruits Corinthian Red). This color often shows in small blotches through the rind itself.

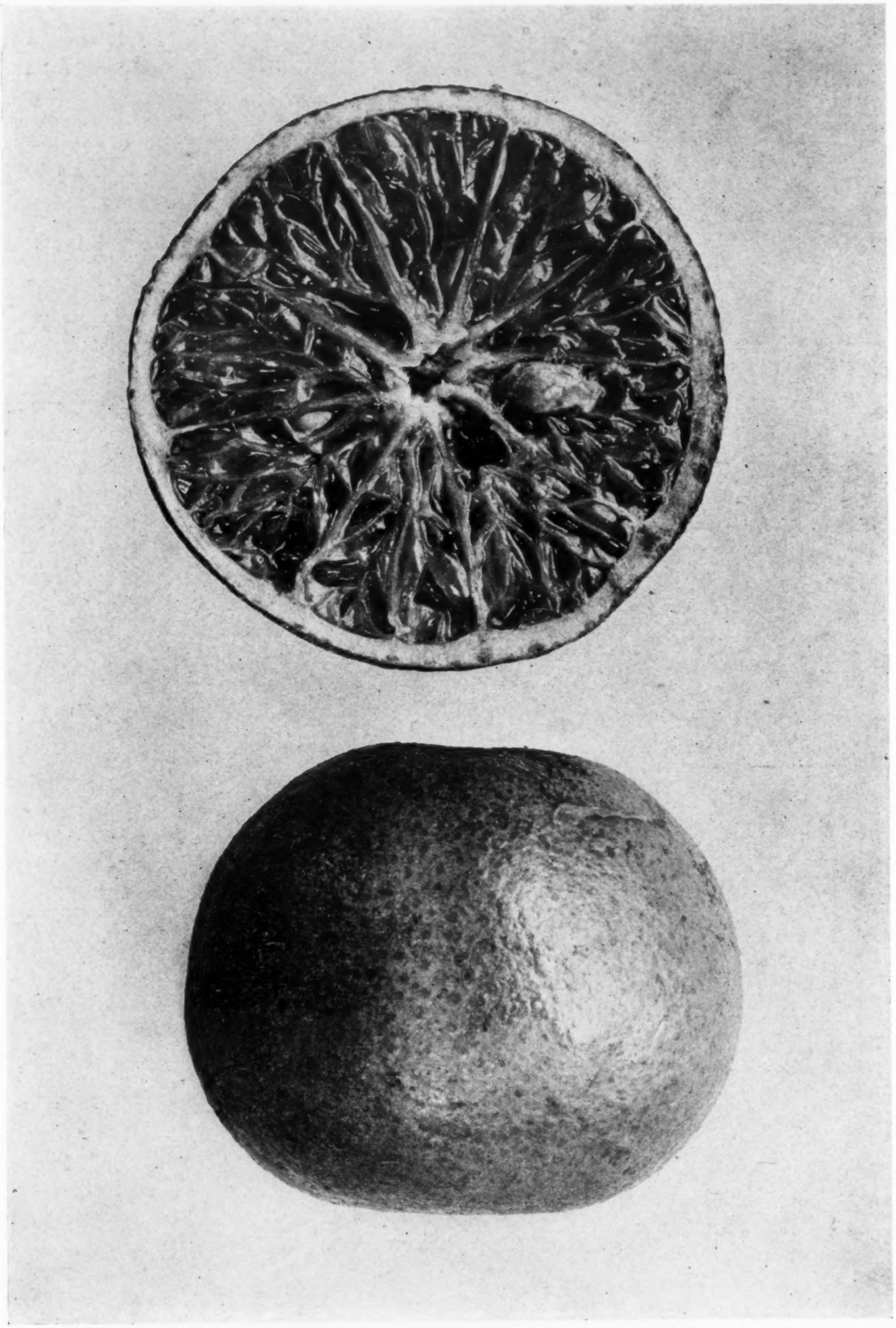
The pulp vesicles, when removed from the fruit, are seen not to be colored, though on cutting the fruit this is not at first realized. The pulp is of grapefruit character, with large vesicles and of pale orange yellow color (Ridgeways, Plate 111, f 17.0–Y.), and it is very juicy. Moreover, this fruit was sweet and apparently mature when first cut on November 6, 1918, a decided departure from the character of both parents as to time of maturity and relative sweetness. In 1919, only a few fruits were borne, and they were much later in maturing. A remarkable feature is the absence from the rind of any bitter principle or pungent oil, the rind itself being very mild and edible. With this character of rind, and the highly attractive color of the pulp this fruit would lend itself especially to the preparation of candied sections, rind and all being preserved in this form.

INFLUENCE OF POLLEN PARENT

The strong influence of the pollen parent is seen not only in the shape, size and exterior appearance of the fruit, but in the foliage characters. Like the Sampson tangelo, the leaves are broad and rounded, rather than tapering at the apex, and slightly constricted, giving a characteristic drawn appearance; the petioles are narrow, in which respect they are more like the orange than the grapefruit.

Figure 3 will give an idea of the character of this new fruit. While generally nearly round, the fruits vary somewhat in shape, some being slightly tapering at the stem end. The shape and size is influenced by its position on the bearing twig—whether

[1] The Sampson tangelo is itself a hybrid resulting from using pollen of the Dancy tangerine on grapefruit, and is a semi-loose-skinned fruit combining qualities of both parents in some degree—color of pulp and rind suggesting the tangerine, but the pulp being more like grapefruit in high flavor and acidity. It is a late maturing fruit, usually ripening from February to April.



A NEW TANGELO

A pink-fleshed citrous fruit created by hybridizing the Sampson tangelo and the grapefruit. Its unusual combination of characters makes it a rather remarkable hybrid; the lining and partition membranes are colored a reddish pink, and the pulp, slightly orange colored, is of grapefruit character but sweet, and the fruit apparently matures earlier than either of its parents. The fruits are about the size of an average orange. (Fig. 3.)

borne singly or occuring in a cluster. The average size is about equal to that of a fair sized orange—2¾ to 3 inches in diameter. It is usually flattened at the blossom end and this half of the fruit is larger than the basal half. The fruits in longitudinal section are usually somewhat asymmetrical or "lop-sided." The fruit in the illustration had nine segments fairly regular, and contained fourteen seeds (fruits usually averaging ten to twelve seeds). The rind is thin or of medium thickness (1/8" to 3/16"); the core is small and solid; it is sometimes slightly open in fully mature fruits. The rind is of pale yellow color (Ridgeway's "Pinard Yellow" to "Primuline Yellow") with rather conspicuous oil cells.

One characteristic of the Sampson tangelo may prove of advantage in the rapid propagation of this type of fruit. Seedlings of the Sampson tangelo have been found to reproduce the original type almost without exception, probably because of the seed being formed parthenogenetically, i.e., without fertilization of the ovary. The seedling thus becomes like a bud from the mother plant, a characteristic that has become apparent with a number of Citrus hybrids when grown as second generation seedlings. Seedlings of this new hybrid are being tested out to determine its behavior along this line.

It is desirable to test out its productiveness, quality and season of maturity on different stocks, and arrangements have been made to do this in several typical citrus sections in Florida. However, until such tests have been made, the new fruit is not to be recommended for grove planting. The unusual combination of characters shown in this hybrid, and especially the occurrence of color in the lining membranes and in the rind (though absent in both parents) renders it worth preliminary notice at this time.

If found worthy of further propagation, a suitable name will be assigned to this new fruit.

Protoplasm in Motion

AMEBOID MOVEMENT, by Asa A. Schaeffer, Ph.D., professor of zoology, University of Tennessee. Pp. 156, price $1.75. Princeton Univ. Press, Princeton, N. J., 1920.

Few animals have played a larger part in biological history than the ameba. Its activities illustrate the operation of the animal mind and body in a simplicity that can hardly be surpassed, while the philosophical evolutionist sees in this humble organism a supposedly close approximation to the earliest ancestor of the animals, man included.

One of the problems that has been widely studied, largely in a theoretical way, is the ameba's method of locomotion; because the same type of locomotion is found widely diffused among animals. Dr. Schaeffer has made extended observations on the streaming of protoplasm in the ameba, and in an interesting little monograph he presents the results. "The wavy path of the ameba represents a projection on a plane surface of a helical spiral"; it is not random but orderly. And "the spiral path is not an acquired habit," it "is supposed to be due to an automatic regulating mechanism which is present in all moving organisms"; moreover "the mechanism is one that attaches to the fundamental structure of protoplasm rather than to the gross morphology." It follows that "all organisms without orienting senses or equilibrating organs, or animals possessing such organs which are rendered ineffective by some means, will not move in straight paths nor in any kind of irregular path, but in orderly paths." The diagrams of paths followed by blindfolded men trying to walk in a straight line illustrate this point fascinatingly.—P. P.

THE PEJIBAYE
A NEGLECTED FOOD-PLANT OF TROPICAL AMERICA

WILSON POPENOE
Agricultural Explorer, Office of Foreign Seed and Plant Introduction, U. S. Department of Agriculture
and
OTÓN JIMENEZ, PH.G.
San José de Costa Rica

IT IS, perhaps, permissible to characterize the pejibaye or chontaduro as a tropical American counterpart of the Oriental date palm. Both species are capable, almost unaided, of supporting life, as proved by Arab tribes which utilize the date as their principal food, and by the aborigines of southern Costa Rica and certain regions of northern South America, who subsist almost exclusively, during part of each year, upon pejibayes. There is, however, this noteworthy difference between the two fruits: sugar is the principal constituent of the date, while starch is the most important nutritive element in the pejibaye.

In Costa Rica the pejibaye has been cultivated by the Indians, principally those of Talamanca and the Atlantic slope, since remote antiquity. Evidences of the important rôle played by this plant in the economic life of the early Costa Ricans are to be found in the accounts of the Spanish historians. In the lowlands of Colombia, Venezuela, and Ecuador it forms a staple foodstuff of numerous aboriginal tribes. The Jibara Indians of Ecuador hold the fruit in such esteem that the ripening season is celebrated annually by a feast of several days' duration.

It seems remarkable, therefore, that this palm, which not only attains great economic importance throughout a considerable portion of tropical America at the present day, but whose value was recognized by Europeans in the first years of American colonization, should not have become widely distributed. Undoubtedly it can be grown successfully in many parts of the tropics, yet its cultivation, as an economic plant, is now limited to that region which lies between the Lake of Nicaragua on the north and Ecuador on the south.

ORIGIN AND NOMENCLATURE

Regarding the native home of the species, Henri Pittier (Plantas Usuales de Costa Rica) says: "The Indians have cultivated it since a remote day, and it is not known as a wild plant; wherever it is found isolated, it may be considered to mark the spot of a former habitation." This refers, of course, to Costa Rica. In Panama it has the appearance of an indigenous species, growing wild commonly in the forest, and to our personal knowledge the same is true of Colombia and Ecuador. In the latter country it is called *chontaduro* and *chontaruru*, a term taken from the Quichua language; in Colombia the name is *gachipaes*, *cachipaes*, or commonly *cachipay;* while in Venezuela it is known as *pirijao* (Carlos Cuervo Marquez: Tratado Elemental de Botanica). Botanically the species is usually listed in Costa Rica as *Guilielma utilis* Oerst. *Bactris utilis* is a synonym. While we cannot be certain, we believe the plant found in Venezuela, Colombia, and Ecuador,

Note.—Lest someone should be led to discount the enthusiasm of the agricultural explorer, (who declares the pejibaye is as delicate and delicious as the chestnut) with the remark that "he was probably very hungry," I cannot refrain from adding this note to say that Mrs. Hamilton Rice who accompanied Dr. Rice on his expeditions into the wilds of Colombia, told me that in her opinion it was one of the most delicious of all the tropical fruits with which she became acquainted in South America.—DAVID FAIRCHILD.

A TROPICAL AMERICAN RIVAL OF THE DATE PALM

The pejibaye or chontaduro grows in Costa Rica, Panama, and northern South America. Throughout this territory it is an important food-plant, occupying a position somewhat analogous to that held by the date palm in Arabia. The specimen here shown is in the garden of Don José Zeledón at San José, Costa Rica. Hanging from the tip of one of the leaves is a nest of the oropendula (Ocyalus wagleri) or social oriole. (Fig. 4.)

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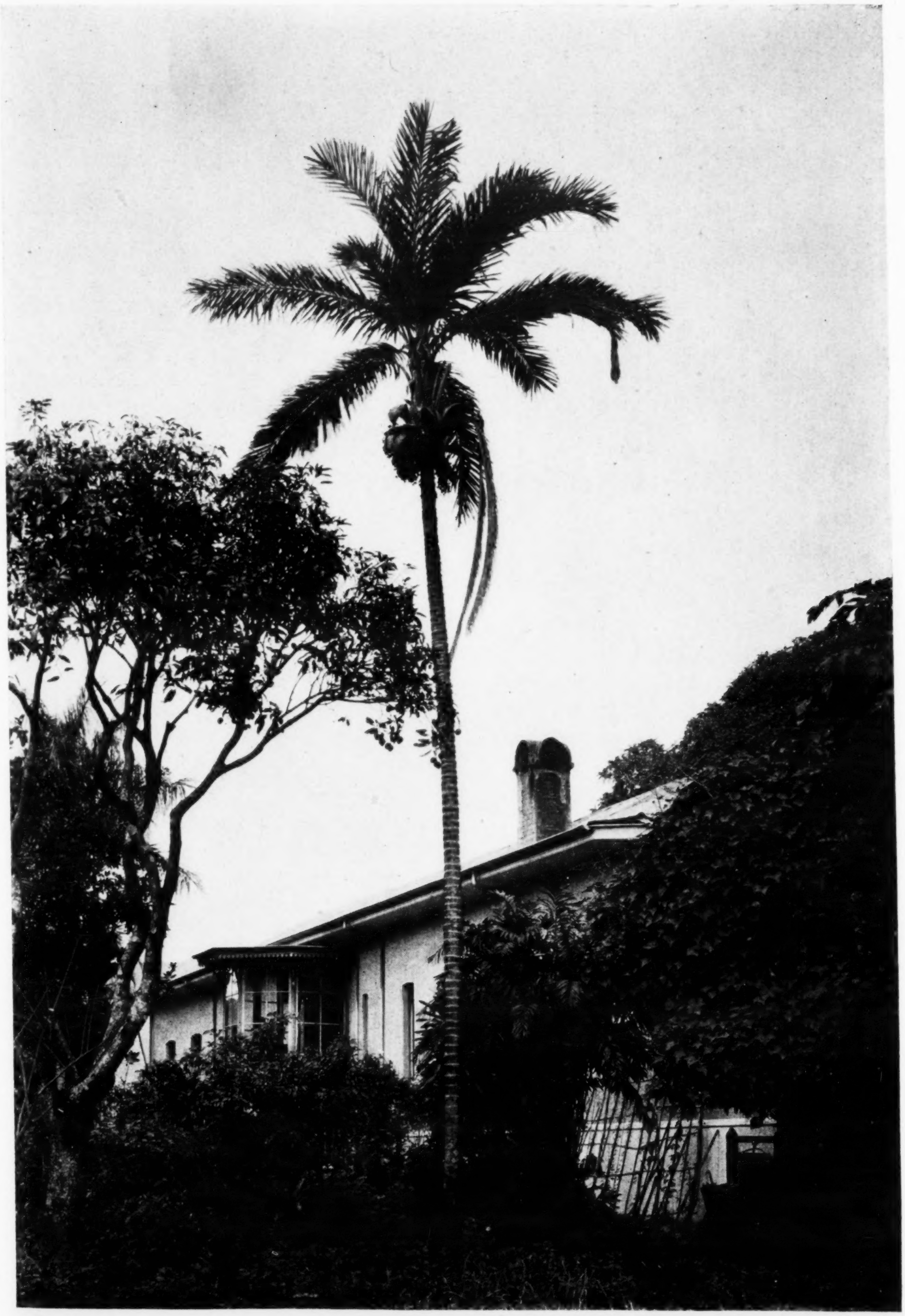

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and which is described in the botanical works of those countries as *Guilielma speciosa* and *Bactris gachipaes*, is specifically identical with the Costa Rican *Guilielma utilis:* plants and fruits examined in Costa Rica, Colombia, and Ecuador appeared to us to be of one and the same species.

Pittier considers the name *pejibaye* (the form commonly used in Costa Rica) to be of South American origin, while Carlos Gagini (Costarriqueiñsmos) states categorically that it is a corruption of the Haitian name *pixbay* or *pijibay*. The word is written in various ways: *pejivalle*, *pejiballe*, *pixbae* and *pixbay* are all found in Costa Rican literature. The pronunciation is pe-hi-vȳ-e (*e* as in pet, *i* as in hither, and the final *e* nearly like the first). Gagini considers *pijibay* the most acceptable spelling, but *pejibaye* is the form preferred in the majority of Costa Rican publications.[1]

DESCRIPTION

The pejibaye palm is a pinnate-leaved species, reaching a maximum height of about 60 feet. Its straight, slender stem, commonly about six inches thick, is armed from the ground upward with stiff, very sharp, black spines about two inches long. These are arranged in circular zones of varying width, those near the base of the stem being four to six inches wide, while higher up the width decreases to one or two inches: there is about an inch of smooth trunk between the zones.

The leaves, which are graceful in appearance, especially when the palm is young, are commonly eight to 12 feet in length, and deep green in color. The rachis is provided with scattered spines.

The species is monoecious in character, staminate, or male, and pistillate, or female, flowers being produced upon the same raceme: the latter occur scattered among the former, and both are small, sessile, and yellow-white in color. The racemes, which are produced from the trunk of the palm immediately below or among the lower leaves, and are protected by erect spathes, are stout, and 18 to 24 inches long. The staminate flowers have six stamens arranged in three pairs opposite the lobules of the corolla; the pistillate flowers have an annular, leathery calyx, a small, round-campanulate, three-toothed corolla, and a trilocular ovary surmounted by three sessile stigmas.

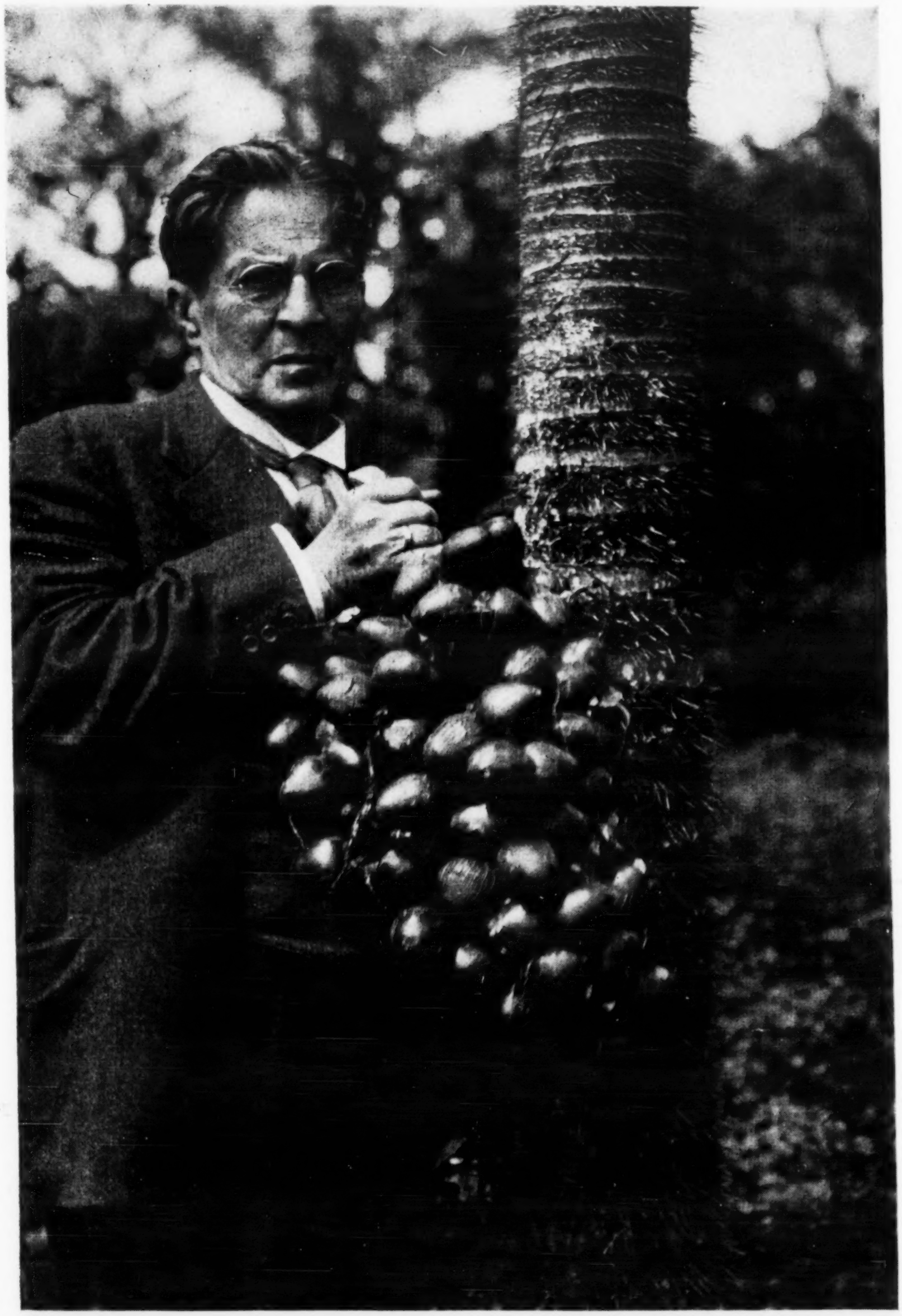
The flowers usually appear during April, May, and June in the lowlands of Costa Rica, somewhat later in the highlands. The first fruits mature in September. From this month until March or April there are usually ripe fruits on the plant, provided the racemes are not cut when the first fruits reach maturity. The long time which the fruits will remain on the palm in good condition is a noteworthy feature of the pejibaye.

It is somewhat difficult to gather the fruit, because of the sharp spines which protect the trunk of the palm. Ladders may be put up, and the racemes cut and lowered to the ground; or, as is commonly done, the fruit may be knocked off with long poles.

Racemes of mature fruits sometimes weigh 25 pounds or more, and five or six such racemes are often produced by the palm in a single crop. The maximum production of one palm (or, more properly speaking, one stem, since four or five stems are often allowed to grow from a common base) is about 150 pounds of fruit. It is seen, therefore, that the productiveness of the pejibaye is similar to that of the date palm.

The individual fruits are top-shaped, conical, or ovoid in form, and vary from one to two inches in length. The base of the fruit is nearly covered by the green, leathery, three-toothed calyx. There is a wide range of variation in regard to the color of the surface, that of some varieties being clear light yellow, while in others the color is deep orange or reddish orange, sometimes shading to brown. The

[1] In English the inappropriate name of peach palm is sometimes applied to this plant.



A NEGLECTED SOURCE OF DELICIOUS FOOD

The raceme of seedless pejibayes which Don José Zeledón is holding at the base of the palm which bore them, weighs about 25 pounds. Four or five such racemes are produced by the palm each year. When it is recalled that these fruits contain as much nourishment as avocados, and far more than bananas, the relative oblivion in which the pejibaye has been allowed to remain during the four centuries which have passed since it was first noticed by Europeans, seems unpardonable. (Fig. 5.)

and which is described in the botanical works of those countries as *Guilielma speciosa* and *Bactris gachipaes*, is specifically identical with the Costa Rican *Guilielma utilis:* plants and fruits examined in Costa Rica, Colombia, and Ecuador appeared to us to be of one and the same species.

Pittier considers the name *pejibaye* (the form commonly used in Costa Rica) to be of South American origin, while Carlos Gagini (Costarriqueiñsmos) states categorically that it is a corruption of the Haitian name *pixbay* or *pijibay*. The word is written in various ways: *pejivalle*, *pejiballe*, *pixbae* and *pixbay* are all found in Costa Rican literature. The pronunciation is pe-hi-vȳ-e (*e* as in pet, *i* as in hither, and the final *e* nearly like the first). Gagini considers *pijibay* the most acceptable spelling, but *pejibaye* is the form preferred in the majority of Costa Rican publications.[1]

DESCRIPTION

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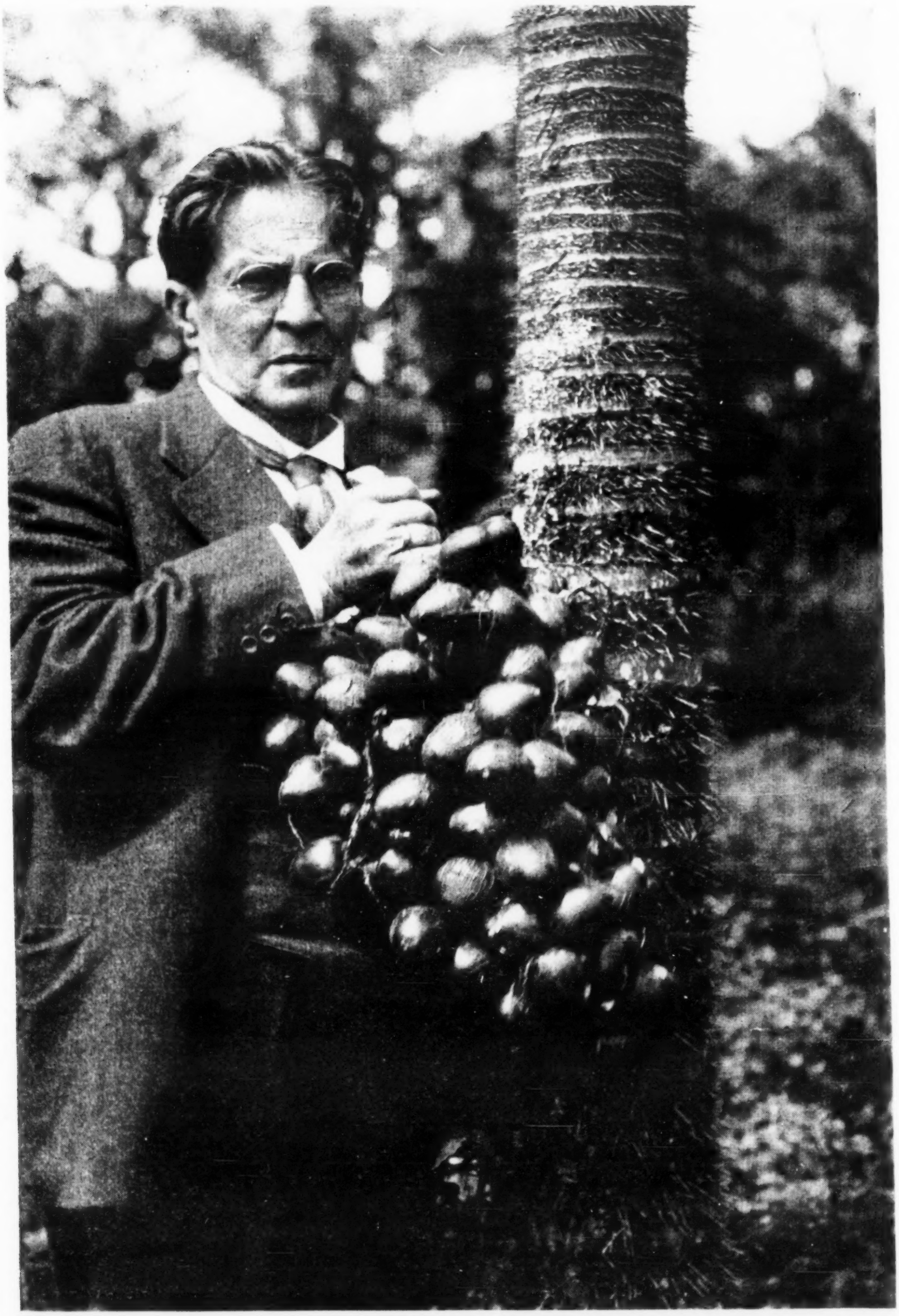

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outer integument or skin is thin: in some varieties it adheres closely to the flesh, even after the fruit has been boiled, while in others it can be peeled readily from the boiled fruit. The character of the flesh is not easily described: it is dry, mealy, yet firm in texture, and pale orange to yellow in color. The single seed, from which the flesh separates very readily after the fruit has been boiled, is conical, somewhat angular in outline, about three-quarters of an inch long, black, with a thin but hard shell enclosing a white kernel resembling that of the coconut in character.

COMPOSITION AND FOOD VALUE

In the following table the chemical composition of the pejibaye is compared with that of several other tropical fruits of high food-value.[2]

José de Costa Rica. This gave the following result:

Starch	26.90%
Sugars	4.00
Fat	5.82

The energy-producing value of the fruits shown in the above table is also a matter of interest. That of the guapinol, as expressed in calories, is 1564; that of the pejibaye is 1096; that of the avocado, as determined by numerous analyses made at the University of California, varies according to the variety and the maturity of the fruit, from 600 to 1,300, with an average of approximately 1,000; while that of the banana is 459.

Of the several fruits here considered, the guapinol has the highest food value. Anyone familiar with this species, however, will recognize instantly that its fruit cannot be considered of economic importance. The guapinol is a leguminous tree common in tropical America: its fruit is a thick, short, hard pod, enclosing several large seeds and a thin layer of dry, yellowish pulp of a peculiar and not very agreeable odor and flavor. It may, in short, be

TABLE 1. CHEMICAL COMPOSITION OF PEJIBAYE COMPARED WITH OTHER TROPICAL FRUITS

Name of Fruit	% Water	% Protein	% Fat	% Carbo-hydrates	% Ash
Guapinol (*Hymenaea courbaril*)	15.1	6.6	1.6	73.9	2.8
Pejibaye (boiled)	48.8	2.8	6.7	40.9	0.8
Banana	75.3	1.3	0.6	22.0	0.8
Avocado (Mexican) variety *Puebla*	66.3	1.8	26.6	6.6	1.5
Avocado (Guatemalan) variety *Sharpless*	71.2	1.7	20.5	5.4	1.1
Avocado (West Indian) variety *Trapp*	78.6	1.6	9.8	9.0	0.8

It will be noted that the figures given above for the pejibaye refer to the boiled fruit. In order to determine the amounts of the principal energy-yielding constituents in the ripe, uncooked fruit, one of the writers has made an analysis of such fruit, under the direction of Dr. Michaud of San

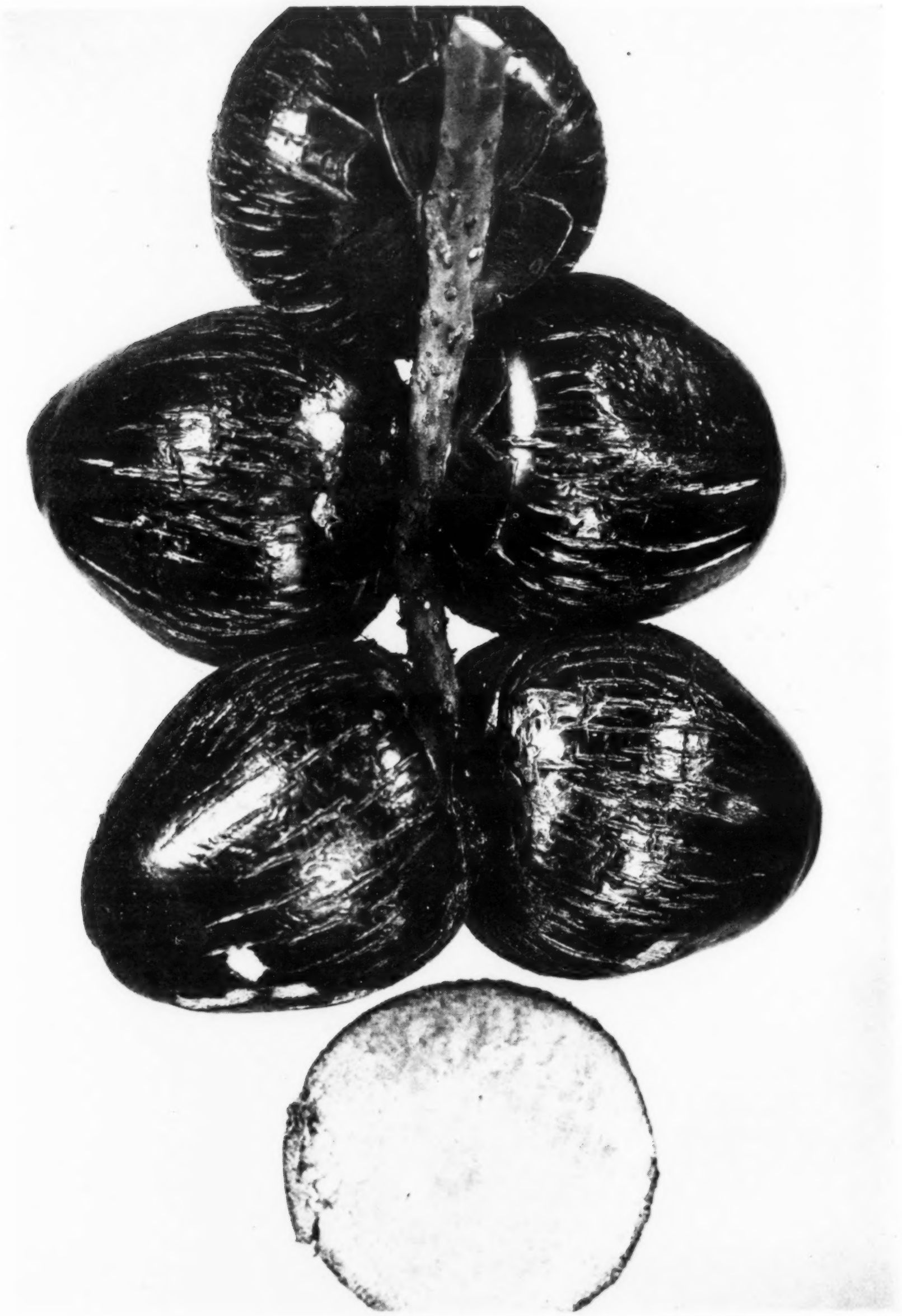
[2] The data concerning the guapinol, pejibaye, and banana are from a table published by F. Sancho, in the Anales del Hospital de San Juan de Dios (Costa Rica), 1917. Those for the three varieties of avocado are from the Manual of Tropical and Subtropical Fruits, by Wilson Popenoe (Macmillan and Co., 1920).

A BASKET OF PEJIBAYES, READY FOR EATING

These fruits have been boiled in salted water. In this state they are offered in the markets of Costa Rica, and are sold in large quantities at a relatively high price, the pejibaye being esteemed by all classes: it may, in fact, be termed one of the favorite fruits of Costa Rica, though the word "fruit" as applied to it in a popular sense is somewhat misleading, since the pejibaye is not sweet, nor acid, but resembles the chestnut in flavor and character. (Fig. 6.)

FRUITS OF THE COMMON PEJIBAYE, NATURAL SIZE

In size and character these fruits are typical of the pejibayes produced in Costa Rica, Panama, and northern South America. After they have been boiled in salted water, as these have been, the skin peels readily, and the hard stone is easily removed. The firm, mealy flesh is eaten without further seasoning of any sort. Its high food value is due to the considerable quantities of starch, sugar, and fat which it contains. (Fig. 7.)



A SPRIG OF SEEDLESS PEJIBAYES, NATURAL SIZE

This excellent variety is cultivated in Costa Rica, and may be propagated, like the date palm, by suckers or offshoots. The fruits here shown were grown in the garden of Don José Zeledón at San José. When ripe, the pejibaye will keep for ten days or more in perfect condition, hence its shipment to distant markets is readily possible. (Fig. 8.)

included among those fruits whose merits are summed up in the classical phrase, "relished by birds and children."

In food-value as expressed in calories, therefore, the pejibaye and the avocado stand first among the tropical fruits of economic value; some varieties of the latter have a higher value than the pejibaye, but the average is about the same.

The relatively small proportion of water contained in the fruit; the large amount of carbohydrates (mainly starch); the considerable quantity of fat; and the small size of the seed compared to the bulk of the edible portion, combine to place the pejibaye among the most noteworthy of the tropical fruits. And it is not only a fruit of high food-value, but it is delicious as well. We believe that it is destined to become a food-plant of great importance in many tropical countries, and it is in this belief that the present paper has been written, in order to bring the pejibaye to the attention of tropical horticulturists not yet familiar with it, and to place on record the available data regarding its culture.

USES

The pejibayes sold in the markets of Costa Rica have usually been boiled in salted water for about three hours. In this condition they are ready for eating without further preparation, except to remove the skin. They are so palatable in this form, that very few efforts seem to have been made by Costa Ricans to devise more elaborate methods of preparation, though enough has been done to show that this fruit lends itself to various uses.

After it has been boiled, the fruit cannot be kept in good condition more than five or six days. Before cooking, however, it has excellent keeping qualities. If placed in a dry room, where the air will have free access to it, the fruit will not decay, but will gradually dry up. If placed in a moist, warm room, fermentation may take place within a few days, and the fruit become useless for eating.

It should be a simple matter to ship pejibayes to distant markets. properly packed, they should keep t days to two weeks, at least, with suffering materially either in appe ance or flavor. It may be mentic in this connection, that it seems fea to dry the boiled fruit and store for an indefinite period. An exp ment made by Doña Amparo Zeledón, based upon a suggestion of Carlos Wercklé, has given excellent results: boiled fruits were pared, the seed removed, and the flesh dried in an oven for several hours. The water was extracted but the fruit retained its form, color, and general character. It was found, six months later, that this dried fruit, when boiled for half an hour, regained the consistency and flavor of the boiled fresh pejibaye.

Like the chestnut, which the boiled fruit strikingly resembles in texture and flavor, the pejibaye is used as a stuffing for turkey and chicken. Dried, it might be reduced to a flour which would serve various culinary uses. But to one who has eaten the freshly boiled pejibaye, there is no incentive for seeking new ways of preparing the fruit for the table.

In addition to the fleshy portion of the fruit, the hard white kernel of the seed is eaten. It resembles the coconut in flavor, and contains a large quantity of oil. The *palmito* or terminal bud of the palm may be used as a vegetable, but its consumption necessitates the destruction of the palm. It cannot, therefore, be considered of much economic importance. The wood, which is dark brown in color, nearly as hard as bone, and takes a fine polish, was used by the Indians in pre-Colombian days to make spears, and for pointing their arrows. It is now employed for walking sticks.

CLIMATE AND SOIL

While the cultural requirements of the pejibaye palm are not fully known, various inferences may be drawn from

its behavior in different parts of Costa Rica. It is abundant in the southern part of this country, and in the central portion on the Atlantic side. On the Pacific side it is seen occasionally in the vicinity of Orotina and other towns. The principal center of commercial pejibaye cultivation in central Costa Rica is Tucurrique, 70 miles from Port Limon on the railroad leading to San José. Here there are regular plantations, made with the object of supplying the markets of San José with fruit.

The pejibaye is a plant adapted to tropical conditions, preferring a region where the rainfall is not excessive (100 inches annually, or less). Regarding its ability to grow at varying elevations, it may be said that it is more adaptable than the breadfruit tree. The latter rarely succeeds in the tropics at elevations greater than 2,500 feet, while the pejibaye fruits successfully in Costa Rica at all elevations from sea level to 4,000 feet, and is occasionally seen at 5,000 feet, though it is said not to fruit well in the cool climate of the latter elevation. At San José, where the altitude is 3,800 feet, excellent fruits have been produced in the gardens of Don José Zeledón and Don Alfredo Brade.

The region of Tucurrique, where most of the pejibayes marketed in San José are produced, lies at an elevation of approximately 3,000 feet, in the valley of the Rio Reventazón, This is a region of coffee, sugar cane, and banana cultivation, with abundant rainfall. The soil is a substantial clay loam, in many places almost a pure clay.

In the banana-growing district a few miles inland from Port Limón, at an elevation of about 100 feet above sea level, the plant is said to be a failure because of the excessive rainfall.

It is doubtful if the species will grow successfully in a cool subtropical climate such as that of southern California. In extreme southern Florida, however, there are probably regions where it will succeed. Concerning its behavior in this state, we have two reports. E. N. Reasoner of Oneco, Manatee County, writes as follows:

"I had *Guilielma utilis* years ago, two specimens 16 to 18 feet tall, which I sold to Mr. Thomas A. Edison, but they died from a cold wave shortly after being established at Fort Myers. I think it too tender for us, but it might succeed in Dade County or Palm Beach County."

Professor Charles T. Simpson, of Little River, Dade County, reports concerning his experience with numerous specimens: "I have tried them in pots, where they do fairly well until transplanted into the open ground. I have planted them in pine land and hammock with equally discouraging results. Edward Brown had a specimen in rich hammock which for a while did well, and attained a height of ten or twelve feet. It suckered freely, and I dug under it, made an incision, and placed a pot in which a fine sucker was soon established. This I later cut off and put in a similar position in my hammock, and for a while it did well. But it soon began to look badly, and finally it died, after I had rooted another sucker from it. I am under the impression that our soil disagrees with it. It ought to be tried down in the Homestead country, where, although there is lots of limestone, there is also a good deal of clay and iron."

In Cuba, Porto Rico, and the other West Indian islands it should find itself entirely at home, and we recommend it as a culture for these islands. In many parts of Brazil it should also succeed, while the Asiatic tropics undoubtedly offer immense regions where it could be cultivated to great advantage.

Three or four palms, grown in the dooryard with practically no expense, would mean the production of three or four hundred pounds of excellent food every year. And this would be a food of delicious character, available during six to eight months. With such possibilities, does not the pejibaye merit attention throughout the tropics?

A SMALL PLANTATION OF PEJIBAYE PALMS

This plantation at Tucurrique is one of the many which supply the markets of San José de Costa Rica with pejibayes. The plant is at home on tropical mountain slopes at elevations up to 4000 feet above sea level. It comes into bearing when six to eight years old, and its life is not less than 50 to 75 years. (Fig. 9.)

CULTURE AND VARIETIES

When grown from seed, the pejibaye comes into bearing at an age of six to eight years, and its life is considered to be 50 to 75 years, or perhaps more. These figures are for the tropical lowlands, *i.e.*, regions below 3,000 feet in elevation. At higher altitudes the coolness of the climate retards the development of the palm, and it may not come into bearing until it is ten or twelve years old.

In commercial plantings, pejibayes should be spaced 20 feet apart. Carlos Wercklé considers that the best system is to allow two to four suckers to develop around the base of each palm, thus forming a clump of three to five stems. Suckers invariably develop after the palm has attained a few years' growth. Some of them may be removed to extend the plantation. It is, in fact, solely by this means of propagation that pejibaye culture may be placed upon the best basis, and for the following reason: the finest varieties are seedless, and must therefore be propagated by vegetative means.

Wercklé states that the best time to remove suckers is when they have attained a thickness of about three inches at the base, and are four to six feet high. At this time they have formed roots, and are easily cut from the parent and established independently. The leaves should be cut back heavily and the plant shaded until it has had time to form new roots; and it must also be supplied abundantly with water during this period.

Regarding the quantity of suckers or offshoots which can be obtained from one palm, it seems probable that the number will not be less than eight or ten. In the few instances where pejibayes have been propagated by this means in Costa Rica, no records have been kept. It is possible that more than ten may be obtained, since the removal of the first offshoots produced may encourage the palm to develop others.

Seed-propagation is the method commonly employed at the present time. The seeds, like those of numerous other palms, are killed if left to dry for a long time in the sunlight. If removed from the fruit, dried in the shade for a few hours, and packed in slightly moistened powdered charcoal, pulverized coconut fiber, or a mixture of charcoal and coconut fiber or charcoal and chopped sphagnum moss, they may be shipped around the world without difficulty. They may be germinated in a mixture of coconut fiber and sand; or in light soil containing an abundance of humus; or they may be stratified in sphagnum moss and potted-off after they have germinated. Wercklé recommends the last-named method, and states that germination takes place in about two months. He notes that care must be taken to keep ants away from the young plants: he has at times lost many through the attacks of these insects, which destroy the first shoots as they emerge from the seed.

The varieties of the pejibaye generally recognized in Costa Rica are few and ill-defined. In other countries where the plant is grown, practically no attention is given to this subject. Costa Ricans speak of the *pejibaye rayado* as the best. This is simply a form in which the fruits are marked by longitudinal scars, and is not a well-defined race or strain. There are pejibayes of varying color and varying form and size; and most important of all, there is the *pejibaye macho* or "male pejibaye," a seedless form. This is a fine large fruit entirely devoid of seed (though Don José Zeledón states that it is common to find on each raceme five or six fruits with seeds in them). Numerous palms which produce these seedless fruits are known in Costa Rica, and some are said to have been propagated by offshoots; but the cause of seedlessness in this species has not yet been determined, and it does not seem altogether certain that the characteristic is one which will, in every case, be inherited. It may be connected with the pollination of the flowers, and some of the palms which

produce seedless fruits in San José might bear fruits containing seeds if transplanted to the lowlands. The subject requires further investigation.

Even in the ordinary forms, however, the seed is not sufficiently large to be objectionable, and since the flesh separates from it readily (after the fruit has been boiled) the seed is not troublesome to one eating the fruit. It is desirable, of course, to plant seeds of a good variety, since there are some which are decidedly inferior: but beyond this nothing is required to make seedlings sufficiently satisfactory to warrant their being planted on a large scale.

In conclusion, we wish to urge upon horticulturists in tropical regions where this palm is not yet cultivated, the desirability of its introduction and establishment as a common dooryard tree; with a view, later, to the extension of its culture, so as to place the pejibaye upon the substantial basis of a profitable commercial fruit, a position which we confidently predict it will achieve if the necessary initiative is supplied to effect its preliminary planting and study.

MILK PRODUCTION OF YOUNG COWS

J. J. Hooper
Division of Animal Husbandry, University of Kentucky

THE question is often asked as to how much more milk will a mature cow yield than a two-year-old cow with her first calf. In other words, if a heifer produces 6,700 pounds of milk and 360 pounds of butterfat during her first year's milking, how much will she yield as a mature cow, and at what age will she mature, or at what age will she produce the largest quantity?

To determine this matter I studied the yearly official test records of 865 Jersey cows, so my work relates only to that breed, although it holds good in a general way for all dairy breeds.

From the table below it is found that a heifer that produces 6,700 pounds of milk and 360 pounds butter-fat as a two-year-old will yield 9,000 pounds milk, and 480 pounds butter-fat as a mature cow, at seven years of age. But she becomes over 90 percent as efficient at four years old, or practically mature with the third calf. Apparently the cow will hold her maximum efficiency through her tenth year.

We find also from this table that young cows gain an easier entrance into the Register of Merit than old cows, and this is true with all dairy breeds. To prove this statement we will call attention to the fact that six-year-old cows exceed two-year-old cows by 101 pounds fat, or by 23 per cent, while the standard for entrance into the official test book has a difference between these ages of 110 pounds (250 pounds for 2 year-olds and 360 for five years and over) or 30 per cent. To state it differently, a two-year-old exceeds her requirement by 30 per cent, and the six year old excells hers by only 22 per cent. But the error is not a serious one.

The records are as follows:

Production of Young Cows Compared with that of Mature Cows

Age of Cow	Number of Cows	Milk	Per Cent	Butter-Fat	Per Cent
		pounds		pounds	
1 year	86	6267	68	337	71
2 "	278	6707	74	359	73
3 "	126	7496	82	399	81
4 "	112	8231	91	449	94
5 "	91	8222	91	441	92
6 "	60	8490	94	460	96
7 "	47	9029	100	477	100
8 "	29	8755	97	462	97
9 "	25	8718	97	476	100
10 "	11	8887	98	464	97

CITY AND COUNTRY—II

Effects of Human Environments on the Progress of Civilization[1]

O. F. Cook

Bureau of Plant Industry, U. S. Department of Agriculture

THE city needs to study the country and the country the city, instead merely traditional, conventional ideas being accepted on either side. Individual interest or preference for the city or the country should not keep us from seeing the different sides of the practical questions.

The relative advantages of urban and rural life have been debated for centuries with no better prospect of a conclusion being reached than in other questions of taste and habit. It means little in itself that country people generally prefer to live in the country and city people in the city. All primitive people believe instinctively that their own life is the best. The naked savages wandering in murky tropical forests, the Arabs in their desert sands, and the Esquimaux in their snowfields, are as firmly convinced as any civilized man that their special way of living is the most to be desired. To prefer what we know and to dread everything else, is the instinctive attitude of the mind. The narrower our existence becomes, the more difficult it is to diverge from the routine path. To break with one's habits, as the French say, is regarded as a supreme misfortune. The instinct of self-preservation that ties us so strongly to life also makes our own existence the standard of individual preference, which we assume that others should share, even against their will.

LABOR AND CAPITAL CONCENTRATING IN CITIES

Cities present many "attractions," to get more people to come in and contribute their money or their labor, so that industries, business and property values may increase. This is natural and inevitable, seeing that cities are not self-supporting, but must draw upon the country. The industrial excuse for large cities is becoming less, with improved facilities of communication and electric transmission of power, but people are crowding into the urban centers faster than ever, and no devices are spared to "keep them coming." "Get ready for the Big City now," as the porter says when the train approaches Los Angeles. Instead of finding ways to resist or to counteract this movement, remission of taxes is being asked, to stimulate the building of tenements, especially in the largest cities.

Continued dominance of urban ideas means that we shall become more and more urbanized, that capital and labor will concentrate more and more in cities, and that rural population and production may soon enter generally upon the stage of decline which many districts are showing. In the last ten years urban population has increased more than seven times as fast as rural population. With two-thirds of the people of the United States living in the cities and towns, the time certainly has come for considering the remnant of farm population, instead of continuing to subsidize urban development at the expense of agriculture. The reasons that have justified tariffs and other direct advantages of urban industries in the past are still applicable to particular cases, but their general purpose has been attained and over-shot. A vast industrial system has been established, and we have gone beyond the equilibrium of agriculture, manufactures and commerce that statesmen of former generations considered essential to our independence.

Tariffs protect against foreign competition, but leave the farmer fully exposed to urban exploitation. War-

[1] This is the second of the two articles on this subject by Mr. Cook, the first paper having appeared in the previous issue of the JOURNAL. The italics in this paper, as in the first, are the editor's.—*Editor.*

time disturbance of values has accelerated industrial expansion and a luxuriant growth of commercial parasitism draws support from the public in high cost of living. Fifty millions a month was the estimated levy of the food speculators on the American public in the war period. When sugar prices began to decline in September, 1920, a quarter-billion "loss" was announced in the speculative "value" that was being collected from the public. Half a billion is the estimate of purely speculative "securities" marketed annually in the United States. The taxes on war profits and excess profits also show something of the extent of the urban abuses that have been allowed to develop, and point to the need of an improved commercial system, not subject to these parasitic excrescences.

DANGERS OF INDUSTRIALISM

The war should have taught us the weakness and danger of urbanism, but the effect has been to drag us closer to the pit that the European nations fell into. That we have more land than the industrial nations of Europe, will not save us if we abandon farming for urban pursuits. "Going back to the farm," is an urban delusion. Many may cherish the hope, but few can attain it. People who are once thoroughly urbanized and habituated to a routine existence are disqualified for rural life. They do not go back to the laborious, complex, and exacting responsibility of farm work unless they are forced by illness, famine ~~or other~~ catastrophe, as in Central Europe where urban industries are being abandoned.

Instead of our national interest being aroused to maintain agriculture, urban industrial development is being pushed forward to occupy the foreign markets in advance of the reconstruction of Europe, with the excess-profits tax working as an endowment or enforced subsidy of enterprises that have thriven most during the war period. In spite of the danger being recognized, no effective measures have been devised to keep the remainder of our farm population from moving to the city—to live on Argentine beef, New Zealand mutton, German potatoes, and Danish butter. In a few years our supplies of food and essential raw materials may become as precarious as those of industrial European countries, and subject to the same danger from wars of industrial competition. The loss to our European race of 35,000,000 people in the recent struggle for industrial supremacy gives no pause to our Gadarene madness. The nations are bedeviled with the idea of exploiting each other, instead of cooperating in the development of a common civilization.

WHY "BUSINESS FARMERS" GO TO THE CITY

Financial experts who see the limits of our present course are urging as "a matter of vital necessity that the efforts of the farmer be supported and stimulated . . . to warrant his staying in the business of farming." Formerly it was assumed that the farmer who made a living should be content, but a new idea of larger returns to the farmer is being expressed, even in urban editorials. "Still, there must be farmers; and farmers must have help; and help enough must be found to make farming profitable." That profits come from the "help" reflects the urban idea that wealth must be got *by exploiting somebody*, but there is no way to keep the help on the farms, or the farmers either, as long as the urban wages are higher, the work lighter, the hours shorter, and the "attractions" brightly painted.

In trying to protect himself against urban exactions, the farmer has become more of a business man. Some writers have hoped that broader business experience would furnish the key to the agricultural problem, but a frequent outcome for the individual farmer is to move to the city and become a middle man himself. Applying urban standards of profit, the farmer decides that he is losing money by staying on the farm. Agricultural

journals abound in comparisons of farming with urban business, leading to one conclusion. "The farmer is operating his business at an actual loss and that is the reason he is quitting the farm." "He knows that he is not getting paid in proportion to the capital, energy and brains he is putting into his business." "The building up of a farm business is the hardest and the most precarious undertaking in the world today." "No other business on earth can stand the handicaps which confront the farmer." "The American farmer today is the most burdened, perplexed and over-worked member of society." Instead of certain percentages of profit being guaranteed, as in many urban undertakings, the farmer has no assurance of even a wage return for his labor. He finds it impossible to agree with Thomas Jefferson, that "The pursuits of agriculture are the surest road to affluence." Now it is the farmer, rather than the factory worker, who feels himself "Condemned, like Sisyphus of old, to roll the stone of labor up the steep acclivity of life."

One writer has discovered from the income-tax returns that " . . . of twenty-two selected occupations the farmer's class contributes least in the aggregate, although it is numerically the largest class in the country." Agriculture, according to this leader of finance, is "a great industry exempt from the excess profit and war profits tax and apparently not effectively reached by the income tax." Instead of being impressed by the unprofitable state of agriculture, the financier argues that the system of taxation must be unfair, and asks whether "the politicians . . . would not devise means to lay an effective tax if the same situation existed in a business industry?"

GROWTH OF DEPENDENCE IN CITIES

As yet there is no control or limitation of the number of people who are allowed to engage in profit-taking "industries," nor of the extent of their exactions. Predatory commerce and finance, in their effects upon agriculture and other producing industries, are more injurious to the public than many of the forms of gambling that have been prohibited by law. *Why should it be considered a natural right to stop producing and go to taking profits or drawing support from the urban rake-off?* For the protection of the public, licenses are required for many kinds of urban business, and this policy could be extended to prevent over-crowding of urban occupations, and much needless parasitism and dependence in cities. To permit unrestricted entrance to the nonproductive "business industries" is like allowing any applicant to begin drawing a pension. The pension system would break down, of course, like the "business industries."

Whether we say that all unnecessary middlemen are parasites, or that all unnecessary costs of handling and marketing are parasitic, the tax on the public is the same, and there is the same need of improving the commercial system, to *stop the present leakage between producers and consumers*. How to eliminate the middleman is being discussed, too often without understanding that a better commercial system must be developed. Profiteering, as we now call it, is nothing new, except that the large-scale operations of recent years have produced the new reaction that the word symbolizes. The stage of exasperation is reached when farmers see no recourse except to go on strike and reduce production, like urban industrial workers. Radical agitators flourish in rural communities, and some of the more primitive elements take to night-riding and burning of tobacco-barns and cotton-gins, to retaliate against "the system," and those who profit by it or weakly support it. In the words of a conservative farm editorial, "The people of the United States might as well accept it as a fact that producers have acquired a class consciousness."

In some respects the feeling among farmers may be compared to that of the Revolutionary period when the American Colonies separated from

Great Britain—the feeling of protest and revolt against commercial exploitation and control by those who do not share the burdens of agriculture, nor understand its problems. Throwing a cargo of tea into Boston Harbor was a lawless escapade, but marked a change in the temper of the Colonies, as historians have reflected. The analogy, of course, is not to be followed in the direction of political separation of the country from the cities. The mutual relations of agriculture with industry and commerce, as parts of our national system, are obvious, and the need of keeping the parts in practical adjustment, if the system is not to be impaired.

STABILIZED MARKETING SYSTEM NEEDED

The recent war-time prosperity of farmers did not mean that the tendencies of our system had changed. No mere flurry of high prices and "good times," but a thorough readjustment of economic, social, and rural welfare conditions is needed, to make farming as profitable, as safe, and as stable as urban business. A prosperous turn to farming, by making it easier to sell land, serves at first merely to facilitate the movement to the city, among those who have been waiting for chances to go. What has to be recognized and corrected is the general effect of our present system to penalize and discourage farming by making country life more difficult and precarious than living in the city. The farmer will have a dependent status as long as the merchant has the life-and-death power over prices, without regard to the interests of agriculture or of the consuming public. An irresponsible commercial system is sure to abuse its power, like an irresponsible government, or a parasitic military caste. Taking advantage of war-time conditions to collect double or treble profits must be reckoned as an abuse of commercial power.

Perishable products have more acute reactions of supply and demand, but no practical reasons have been discovered for the very wide fluctuations in the prices of imperishable products like cotton. Since it is possible to know in advance the kinds and quantities of fiber that are needed, and to approximate the costs of producing, transporting and storing a normal crop of cotton, a practical marketing system might be worked out, at least to the extent that farmers who raise normal crops would not be forced to sell for less than the production costs. The natural consequence of making business more profitable than production is to have *too much business and too little production*. Business depressions alternate with business inflations, for lack of adjustment of the commercial system to the needs of production. Stable prices and a steady flow of trade are in the interest of producers and consumers, but speculators must buy low and sell high, to get their profits. Speculative dominance of markets turns the whole system of trade into an agency of exploitation. That "business confidence" is so important a factor in the prosperity of agriculture or other producing industries, shows how precarious our system is, how completely it is built on the sand of speculation. The farmers do not get good prices for their cotton unless the urban speculators are taking chances that cotton will go still higher!

SPECULATION REACTS ON PRODUCTION

Over-exploitation, rather than overproduction, is to be considered as the cause of urban panics and agricultural crises. When business over-reaches too far, the "demand" is suppressed. Excessive profit-taking interferes with normal consumption, and production gets a needless set-back. Speculative derangements of the commercial system discourage farmers and restrict production no less than root-rot or boll-weevils. That we do not produce enough sugar, oil, wool, or long-staple cotton for emergency needs, was recognized as a national danger during the war. How to protect agriculture against speculative boat-rocking and mob-psychology in urban markets, may be learned in time, and how to dis-

tinguish predatory profits from legitimate returns for the labor of production and distribution. Fixing of prices may not be feasible, but relative values of different products may be recognized to avoid the dangerously artificial "values" that speculation develops. With markets once stabilized, we would look back to our present commercial vicissitudes as not much better than trading cotton bales for lottery tickets.

Improving agriculture by lending more money to farmers is another urban remedy, more specious than practical. How shall credit facilities be equalized while farming remains precarious and unprofitable in comparison with urban industries? Many farm products are too perishable to serve as security for loans, and even an imperishable article like cotton is subject to speculative impairment of value. Too much credit is given for speculative farming, to those with little knowledge or judgment, who rush in to make fortunes from high-priced crops. The financial risks of such undertakings are not good, and regular producers are injured by having their markets destroyed or stampeded Loaning and speculating are "business industries" that are easily overdone, and sap too much from production. Not a larger use of credit by farmers, but *less need of borrowing money and paying interest* would mark a real improvement in the economic status of agriculture.

The relations of city and country are becoming acute because the city has so many new ways to reach out to the country. Urban propaganda have gained an enormous momentum. Even farm papers are published in cities, and draw rural apostles to town. In primitive times, with facilities of communication undeveloped, urban parasitism could destroy only neighboring populations, but modern cities draw supplies and people from remote regions. Tendencies that under more primitive conditions would work out in centuries may now become effective in decades.

ROME FELL WHEN ITS AGRICULTURE DECAYED

It is the way of civilizations to become urbanized, and of city populations to lose touch with agriculture. The farm is where we climb up the scale of civilization, the city where we run down. Our nearest analogy is with Rome, an imperial republic that outgrew the older nations and centered the activities of the Mediterranean world. Liberty enlightens and energizes, but with progress more rapid there is more danger of running completely off the track. In the constructive phase of their civilization the Romans were devoted to farming, but agriculture decayed in the period of political and commercial expansion. "For many centuries war and the cultivation of the soil were regarded as the only occupations befitting a free-born citizen." Yet a few centuries of urbanism wrought complete destruction. The Roman agriculture had a family organization at first, slavery during the period of foreign conquest in the late republic, and tenant-serfdom in the stage of imperial decline.

Cato and other patriotic statesmen foresaw the ruin of the Roman system when agriculture began to decay. Augustus and Maecenas were at pains to enlist the talent of Virgil and Horace, to secure the most attractive expression of the rural traditions and ideals of the nation, and lead the currents of thought away from the city. Remedial legislation in many forms was attempted, and especially to attract tenant-farmers to the public lands, but production and population continued to decline. A fever of speculation ravaged the Roman world in the last centuries of the republic, and added to the devastation of the civil wars. Feeding and amusing the urban proletariat became the chief tasks of the government, until the whole parasitic system broke down and was swept away by the northern barbarians.

That our age is more scientific—more inclined to investigate and recognize facts—should give us better

prospects of finding safe courses and maintaining our civilization, unless we drift too far before beginning to take thought of agriculture. Painting "The Man With The Hoe" inspired an eloquent protest in verse, but literary powers of projection need also to be used constructively. Not indignation over past "wrongs" or primitive limitations, but a spirit of clear intelligence and practical human interest needs to be inspired, if we are to find the way out.

THE TOLL OF CITY LIFE

Food to maintain our cities is not the chief concern. Urban populations are transitory, even if supplied with food. Withdrawing the rural population is worse than destroying the city, because *the life of the nation is in the country*. Families seldom last more than two or three generations under urban conditions. The lowest birth-rate is in well-to-do urban families. If only the weaker and less capable were eliminated, a beneficial eugenic function could be claimed for the city, but even the best stocks deteriorate in the urban environment. The rich and "middle-class" families are eliminated even more rapidly than the poor. Thus the natural rule of survival of the fittest does not apply in urban selection. Putting all the presentable young women on the stage and choosing the strong, alert, prepossessing young men to serve the public as retail tobacconists or haberdashers' assistants may be good business, but certainly it is not in the interest of the nation and the race! Eugenic regulation of urban employment may be far ahead, but with an enlightened public sentiment able-bodied and right-minded young men would be shamed from spending the years of vigorous youth in work that can be done by old men or cripples. "Our boys are mad with the city," and many urban "industries" are spreading this contagious insanity.

War is condemned for reasons of eugenics, because the strong men are taken and the weak left at home, but *the city destroys whole families*. The process of selection and elimination is repeated in each generation—bright boys from the country becoming successful merchants, wealthy bankers, or great captains of industry, but usually leaving few descendants, and these in artificial environments of wealth, luxury and parasitism. Urban employers prefer boys and girls from the country, as being more responsible, resourceful and adaptive. The recent arrivals prosper, while the mass of urban populations is crowded gradually into the discard. Continual drafting of the more capable stocks to the city is a process of adverse selection, leading inevitably to deterioration of the race and to decay of civilization. "For it has been heretofore always the case that men under the influence of civilization, though at first improving, afterward degenerate." Agriculture is the root of civilization, and the plant dies when the root decays.

Urban conditions no doubt are the more destructive because our northern races are not accustomed to cities, which came late into Europe, through the Oriental contacts of the Greeks and Romans. Only the Jews, with their strong family and religious organization, have been able to sustain through the centuries an urban existence. Preference for cities may be traced back to the Oriental idea that labor is a curse, and money the chief blessing, to buy leisure, luxury and social standing. Primitive defects of human character become dominant again in cities, the family organization of society is dissolved, and we are back in barbarism. Greed, vanity and display are the social growths of urban soils, that bear the poisoned fruits of envy, hatred and revolt. Ostentation is the veritable seed of anarchy. The barber gets a "close-up on society" at the horse-show, and is ready to throw bombs.

City people, of course, are not all urbanized, or to the same extent. Some are country-life enthusiasts, with zeal intensified by a sense of privation. The hope of being able to live in the country is the mainspring of many

city lives, as of country people to retire to the city. Many families spend their summers in the country, and maintain their interest in out-door life and farming. Families that break the rural contacts are at a greater disadvantage in the city, and the sooner obliged to choose between the suburbs and the slums. The city does not fill up and flow back to the country. The current may slacken at times, but never stops. As a net result of urban striving the cities are richer but the race poorer, and less able to maintain the structure of civilization. It should not surprise us that hygienic surveys are showing larger percentages of deformed or abnormal children in country schools than in neighboring cities. With the best blood sapped away in each generation, it must be expected that only a remnant of persistently rural-minded people will be found in the country, and a residue of the inert, incapable or defective. After the wheat is harvested, the weeds grow!

OUR MOST FUNDAMENTAL PROBLEM

If the adverse selection of the city is beginning to show definite lesions of inferiority in the country, the problems of urban parasitism may receive more intensive study, and the ways of reversing the present tendencies, so that the more capable elements of each generation may remain in the country and raise families, instead of going to the city to be eliminated. There is no real competition or conflict of interest, since the city also is menaced if the rural population is impaired. *More fundamental than any other issue is that of conserving superior race material for rural progress*, instead of having our best boys and girls drafted into the city to be entangled and lost in the "jungle" of urban exploitation, industrial, commercial, and financial, or even in "rescue work." Urban misery cries from between the millstones, but the grinding goes on, in spite of philanthropy or revolt. Urban interests have exploited each other and scrambled for the fruits of agriculture from the beginning of history.

As long as we think of agriculture merely as tributary to the city, neither the farm problems nor the problems of labor and capital are likely to be solved, or even understood in their essential relations. Work that is exploited is also despised. Agriculture must be appreciated and developed, not for urban exploitation, but as *the normal life of civilized people*. The first step is to escape the urban prepossessions, by seeing that agriculture is fundamental and deserves primary consideration for its own sake, because it has richer rewards of satisfaction for the normal human instincts, and a larger outlook to the progress of civilization and the welfare of the race. In the words of Washington: "Agriculture is the most healthful, most useful, and most noble occupation of man." And this, we need to see, is not an out-grown sentiment, but living wisdom, for the present and the future. Leaving the land for the city is turning away from life. Education should teach us this, and how to live in the country. Ideals have first to be humanized, before the problems can be studied with constructive insight.

The Progress of Research

Those who sometimes feel impatient at the apparent slowness of research work should visit the fields and laboratories where the work itself is being conducted, and they would appreciate this reply which came to one of the JOURNAL's recent requests for a report on a special investigation: "It is true that I am collecting extensive material on ————, but I am not at this time ready to make even a preliminary report on the subject. I may possibly have something for you in this line two or three years later."

VISIBLE RECORDS OF HEREDITY

Lack of Photographs of New Hybrid Forms an Irreparable Loss to the World

DAVID FAIRCHILD

THE experience of the past seven years in the conduct of the JOURNAL OF HEREDITY has shown most conclusively a pathetic short-sightedness of many research workers in the gathering of those most useful of all things, the photographic records of their work.

It is not uncommon to find that a breeder has worked for years; has produced a host of most interesting forms, and at the last moment, just as he sees them going out of flower or fruit, has sent a boy with a kodak to photograph them. All the visible record of his work the boy must try to squeeze into the space of a three and a quarter by four and a quarter film. The result is that when the research man comes to show his results to the interested public he fails completely. He cannot describe the forms which have disappeared or which, like a comet have gone for a whole year. He can only say to his friends, "If you could only have seen them;" or, "If you could only come in May and see them again."

One of the most prominent men in the field of animal genetics said to me the other day he had often wished he had taken photographs as he went along, so that now he could portray the changes which have taken place in his guinea pigs. And all of us could add similar instances.

If we research men would put a small fraction of the time which we devote to getting our results, into a study of how to photograph them adequately so that they will show just what these results are, our work would be immensely benefited by the effort.

The world will look at pictures. It can understand those that are properly made and that are large enough to see easily. It will not take the trouble to imagine in a tiny kodak view the details which the research man can see plainly because he knows before he looks at it what to look for.

I believe it is a mistake to depend upon a professional photographer to get what one wants shown. He cannot have your point of view and is trying for something else—a pleasing effect. He almost involuntarily does this. It has taken us years of painstaking work to educate the official photographers in the Department of Agriculture to get what we want portrayed, and an inexperienced man cannot get what you want. Put your own head under the black focusing cloth and arrange your own photograph.

But in getting scientific accuracy don't forget that the professional photographer was right too—you must make your picture attractive to give it the greatest value.

The background of a picture is of great importance in making it attractive. An ugly fence or the bare side of a house or barn will spoil the looks of any photograph.

Remember that it is the unusual point of view that attracts. Remember that the near view is usually more striking than that taken from a distance. Remember that it is not necessary to show all of an object; the eye will complete it just as it does a fragment of a landscape.

Perhaps the very most difficult thing to show in the photograph of a fruit or flower or small plant is its size. It is quite common to put a measuring stick in the photograph, or a surveyor's pole, or to try to give scale by a cane stuck in the ground, or a man's hat or a jack knife laid on the table. Curiously enough, these things not only ruin the beauty of the picture but fail to give an idea of the size. It takes a conscious effort on the part of the observer to translate it. He says

to himself, "A cane is about three feet long—this little tree is taller than that, yes it must be about four feet high, and that would be about so tall," and measures the height with his hands. If a child had been standing by the little plant or a dog or domestic animal of some sort, the approximate size of the plant would have been realized unconsciously, regardless of the fact that one does not know the size of the child or dog.

There are of course cases in which absolute accuracy is desirable, and in such photographs a scale at the very edge of the picture may be necessary, but ordinarily the general impression must be depended upon to give the size, for the general reader does not stop to analyse a photograph. A scale photographed at the edge of each photograph which can be cut off when it is used for other than record purposes is of course an excellent precaution though in most cases a statement of size is just as good.

If you pose a man or woman for a scale, be sure to have an attractive one, though don't do as one person I know did. He asked such a beautiful girl to hold his fruit for him that no one looked at the fruit at all! On the other hand, thousands of remarkable photographs are ruined by the hired man in his glaring white shirt sleeves; and a hat thrown on the ground, for some reason or other seems to distort most photographs of plants or animals. One wonders perhaps why the man put his hat there.

The careful use of part of a human figure can be made to give scale, but it must be very carefully done; to ruthlessly chop off a man's head in a picture gives the reader something of the same kind of a shock that the photograph of a detached arm does in a medical publication. Don't do anything that will deflect the attention from the object to be shown. If it is a small object, get close to it and make it cover a large part of the plate. If some one must hold it, show him looking at it in an interested way, and the eye of the reader will follow his gaze, but don't unbalance the picture by putting too much of the man in and too little of the object. Human eyes staring at you from a photograph will always unbalance it. You must meet them unconsciously with yours and fail to see the object which the photograph was taken to show.

There seems to be some relation between the size of the object and the amount of the background space around it. If this space is little, the impression of largeness is given. A cherry which is enlarged to nearly cover a 5 x 7 plate looks as large as a pumpkin, and yet the enlargement is only 3 diameters while a pumpkin occupying the same space on a 5 x 7 plate gives a confused idea of its size though the object is shown only $\frac{1}{8}$ its natural size. There is a mysterious psychological relation here which I wish some one more skilled than I am in such matters would explain. By trial and a study of the effects, one can get approximately the right proportion, so that one unfamiliar with the object gets at a glance a reasonably correct impression of its size.

Remember that in the almost microscopic details of a head of wheat or a hairy leaf are to be found fascinating forms which to the layman are new. There are few less interesting photographs, however, than those of a whole wheat head with its long awns because it has to be so small that it appears,—well, it appears to be nothing but a head of wheat,—whereas the fascinating richness of form to be found in a head of wheat is well known to every hybridizer of this important cereal. The public at large is still puzzled to tell a head of wheat from a head of rye or barley. Get enlarged photographs whenever they will show the new point to be illustrated and devise new methods of showing off the old forms. A photograph of a cow for example, to the layman is nothing but a cow, but a cow's udder or tail he has probably never seen photographs of. While small photographs can be enlarged it is a mistake to think that clearness is not lost in the en-

largement process. Five by seven photographs are in the long run none too large.

The work being done by the breeders of this country is second to none in importance, and every means should be taken to make it more generally known and more interesting to the intelligent public. Striking photographs, unusual ones, will always attract interest and focus attention, as shown by the great use of pictures in commercial advertising. If the methods of business are successful, why should we not copy them?

The plant and animal breeder only travels his path once. He hurries along it. Let the sunlight make some sort of a trail behind him which those who come after can read! The printed word was once the chief method of thought conveyance through the eye, but today we have a new way and many of us apparently do not realize it when it comes to our own special field of work.

Take photographs liberally. Take such as tell the story adequately. Remember you will need series of them. Study the arrangement of your objects. You will be amazed at the way these photographs will increase the romance with which as a scientific man you surround yourself. You will leave behind you a record which will be far more accurate and perhaps quite as valuable as the written notes you make which give only your own interpretation of what your imperfect eyes see and your imperfect memory recalls. The scientific man who must follow you wants your ideas of course, but he wants to see just what you saw and make his own deductions, or perhaps develop some entirely different theory from the one you were working on.

Photographs are a record which anyone can read and subtle differences can be pointed out easily in good photographs that reams of description could never make plain. The JOURNAL OF HEREDITY must depend for its appeal largely upon good photographs to explain the scientific language of its writers, and research men in genetics should study with assiduity this subject of photographs in order that their work, which this JOURNAL is published to help, shall not die still born but that it shall have a chance to attract to it the young workers who are to take it up and carry it on. If the institutions of research cannot afford to equip themselves with adequate means for the recording of the results of their investigators, let them see if they cannot cut down expenses at some other point than the one concerned with the photographic records of their achievements.

COPIES OF SCIENTIFIC ARTICLES

MANY scientists lack the library facilities which their work demands. They are compelled either to journey to distant libraries or to try to borrow books by mail. Often it is difficult for them to locate something that is badly needed, and again it may be impossible to borrow it.

The Research Information Service of the National Research Council is prepared to assist investigators by locating scientific publications which are not generally or readily accessible It will also, as is desired, have manuscripts, printed matter or illustrations copied by photostat or typewriter. The cost of copying varies from ten to twenty-five cents per page. No charge is made for this service unless an advance estimate of cost has been submitted and approved by correspondent.

Requests for assistance should be addressed, National Research Council, Information Service, 1701 Massachusetts Avenue, Washington, D. C.

THE "PROTECTIVE COLORATION" THEORY

A Word of Comment Regarding Its Application to Birds as Outlined in a Previous Article in This Journal

T. BARBOUR
Museum of Comparative Zoölogy, Cambridge, Mass.

I HAVE read with interest Mr. Woods's "Random Test in the Theory of Protective Coloration."[1] This simply consists of presenting photographs of four of the very pleasing little habitat groups which have helped in the much needed modernization of the venerable Boston Society of of Natural History. They represent: (1) Piping Plover on sand and rocks: (2) The next of a Night Hawk on the ground: (3) The nest of a Phoebe among dark green rocks near the water: (4) A Whippoorwill with its nest arranged like the nest in the Night Hawk group.

Now the Limicoline and Caprimulgid groups of birds offer many examples of undoubted protective coloration which have been recognized, described, admired, discussed and admitted as useful to the birds by all naturalists both "field" and "closet" since the dawn of ornithology. The groups of Piping Plover, Whippoorwill and Night Hawk afford no "Random test" for they, as they depict true conditions, inevitably illustrate century old examples or protective coloration and this was well known to us all when the groups were installed. The Phoebe group is in a slightly different catagory. We have sought to illustrate the primitive dwelling place of the Phoebe; no easy task now that practically the entire Phoebe population has come to the conclusion that it is easier not to worry about the relationship between dark green rocks and its coloration and has found that the struts and beams under bridges offer most ideal building sites.

The theories of Mr. Thayer, the artist, here so handsomely endorsed, are in reality only in small part essentially optical. To delimit them especially to determine just what is new, needs not perhaps to "involve learned discussions in natural history" but this appraisal does need common sense and knowedge of the exact ecological conditions under which animals live and of the published literature. We remember in regard to the introduction of dazzle painting of ships that naval authorities differed sharply in valueing the protection afforded. Moreover, the protective value of the "bright and often dazzling colors of birds" has not in any way, shape or manner been *proved* by Mr Thayer's "elaborate and magnificent book," although most suggestively discussed, with many novel and valuable possibilities pointed out for future debate and perhaps in time for experimental confirmation.

The foregoing article was submitted to Dr. Woods as a member of the editorial board of the JOURNAL, who contributed the original discussion, and he returned it with the following note.—*Editor.*

New York, May 26, 1921

Mr. Oliver Olson,
JOURNAL OF HEREDITY,
Washington, D. C.
Dear Mr. Olson:

Enclosed is Mr. Barbour's "Word of Comment." I think that his criticism is, to a great extent, justified. I do not consider that this contribution, which I made, towards the subject of protective coloration was more than a very trivial one. Its title, and in places its contents, evidently convey a seeming importance beyond what this scanty and insignificant material could justify. Let us hope that the discussion of Abbott Thayer's interesting, and often provocative theories may be continued, and especially by those who as artists, or naturalists, are as specialists, qualified to do so.

Very truly yours,
FREDERIC ADAMS WOODS

[1] JOURNAL OF HEREDITY, 11, 6, 1920, p. 284–285, figs. 20–32.

DATURA—AN INVITING GENUS FOR THE STUDY OF HEREDITY

W. E. SAFFORD
Bureau of Plant Industry, U. S. Department of Agriculture

THE GENUS Datura belongs to the Solanaceae, a botanical family remarkable for the narcotic properties of many of its members. Perhaps the most celebrated of them all is the mandrake (*Mandragora officinalis*) so frequently mentioned by Shakespeare, which during the Middle Ages was used in amorous incantations and was believed to have magical virtues. According to early herbalists it would shriek aloud when torn from the ground, causing deafness and even death to him who dared gather it. To escape the penalty, a dog was used by the herbalist to wrest it from the ground, the earth having first been carefully removed from about it and the dog tied to the stalk. An early illustration represents the dog writhing in the agonies of death after having accomplished the feat. Other famous narcotics of the Old World Solanaceae are the deadly nightshade (*Atropa belladonna*), henbane (*Hyoscyamus niger*) and the dutra or dhatura (*Datura metel*) of the Hindoos.

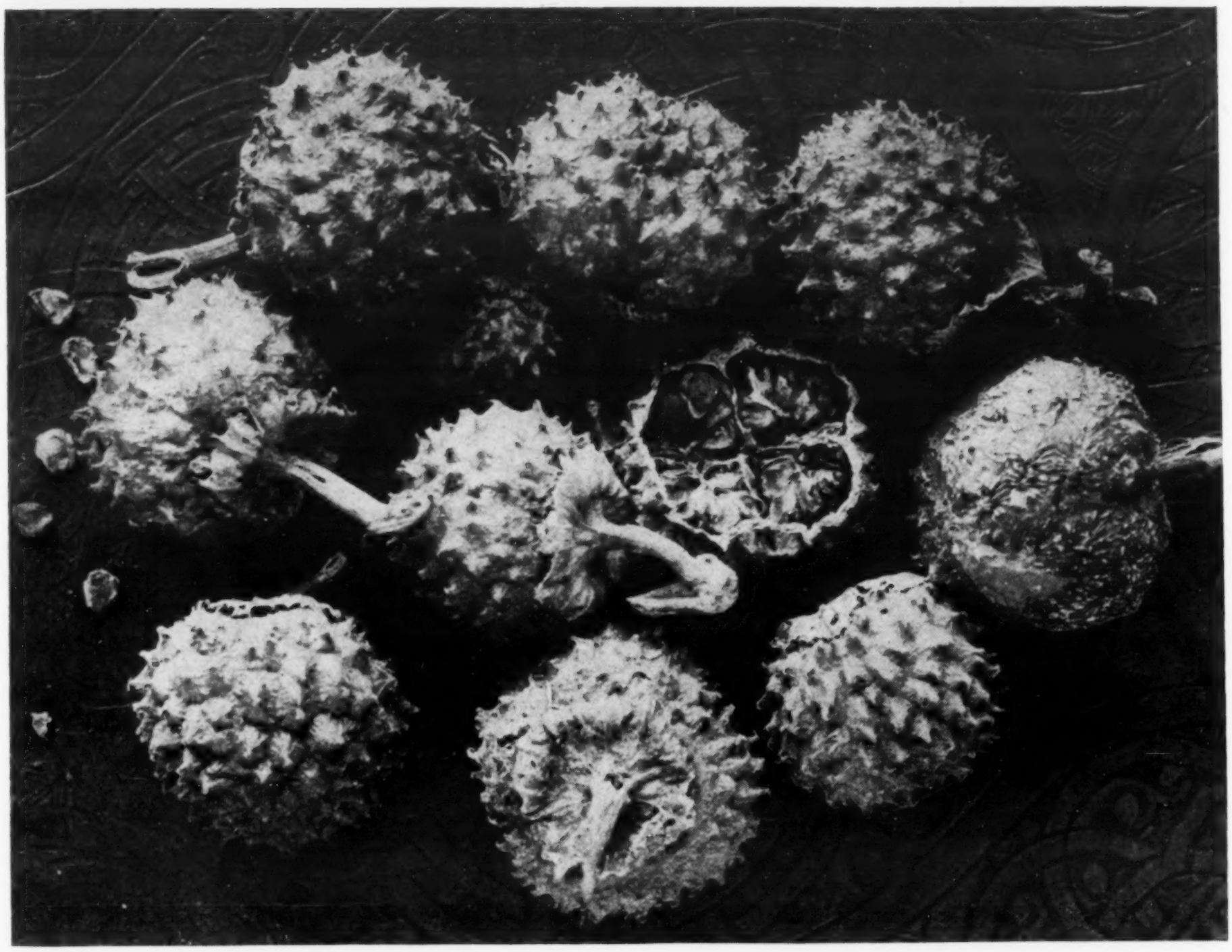
The last named plant derives its specific name from the *jous-methel*, or "metel nut," of the Arabic pharmacopaea, described by Avicenna in the eleventh century together with *nux-myristica*, or nutmeg, and *nux-vomica*, or strychnine. From Dioscorides' translation of Avicenna's description, this so-called nut was recognized by Matthioli and other early botanists as the fruit of a solanaceous plant, which was figured in 1542 by Fuchsius under the name "Stramonia, or Rauchaepffelkraut." In establishing the genus Datura two centuries later, Linnaeus formed a generic name from the East Indian *Dutra*, or *Dhatura*, giving it a Latin form, and explaining it by the following pun: "Daturae, licet originis sit peregrinae, vocabulum persistere valet, cum a latina derivari potest; dantur et *daturae* forte in Indiis posthac semina a lascivis foeminis maritis inertibus."[1]

Fig. 10 is reproduced from a photograph of East Indian metel nuts in the drug collection of the United States National Museum. Fig. 11 is a reduced reproduction of Fuchsius's illustration referred to above. In this figure the corolla is represented as 6-toothed, but normally it is 5-toothed.

SEVERAL VARIETIES DESCRIBED

In establishing the specific name *Datura metel* in the first edition of his Species Plantarum (p. 179. 1753), Linnaeus definitely states: "Habitat in Asia, Africa," and cites his previous description of it in Hortus Cliffortianus (p. 55. 1737). Here it is called *Datura pericarpiis nutantibus globosis*, and is identified with the Arabic metel-nut and the East Indian dhatura, or dutra, "by many called Stramonia." Several distinct formsor varieties are described; among them, α, with a double white corolla (*flore albo pleno*); β, with a simple white corolla (*flore violaceo simplici*); γ, with a double or triple violet corolla (*flore violaceo duplici triplicive*): δ, with a double corolla white within and violet without (*flore pleno, intus albo, foris violaceo*). In the accompanying illustrations (Fig. 12) are shown the typical form of *Datura metel* L. with simple white corolla (No. 1) together with its dried fruits, "*pericarpiis nutantibus globosis*" (No. 2), and its varieties "Flore albo pleno" (No. 3) and "flore pleno, intus albo, foris violaceo" (No. 4), the two last named photographed from plants propagated at Arlington by Mr. H. A. Allard of the Bureau of Plant Industry.

[1] Linnaeus. Hort. Cliffort, 56. 1737.



THE ARABIAN JOUZ-METHEL, OR METEL NUT

Described by Avicemna in the eleventh century (*Datura metel* L.). These are specimens from the drug collection of the U. S. National Museum. Datura is a genus of large, coarse, rank-smelling, poisonous plants of the nightshade family, growing in waste places, with large, showy, funnel-shaped flowers succeeded by globular, prickly, four-celled capsules. All the species, of which the thorn-apple or Jimson weed is the best known, possess narcotic and poisonous properties. (Fig. 10.)

There can be no question as to the identity of Linnaeus's *Datura metel*, and there can be no excuse for calling it *Datura alba* or *Datura fastuosa* (the latter name applied to its forms with double corollas) nor for transferring its perfectly valid name to the American "downy thorn-apple" (*Datura innoxia*) described by Miller in 1768.[2]

Both the white-flowered and the colored varieties of *Datura metel* are used as intoxicants; it would be interesting to determine which is the most efficacious. In 1563 Garcia de Orta, physician in charge of the hospital of Goa, Portuguese India, published an account of the criminal uses of dhatura by servants and highway robbers. Thirty-three years later Huyghen van Linschoten, in the journal of his travels, described its use by the woman of Goa as follows: "They have likewise an hearbe called Deutroa which beareth a seed, whereof bruising out the sap they put it into a cup or other vessel and give it to their husbands, eyther in meate or drinke and presently therewith the man is as though hee were halfe out of his wits and without feeling, or else drunke (doing nothing but) laugh, and sometimes it taketh him sleeping (whereby he lyeth) like a dead man, so that in his presence they may doe what they will and take their pleasure with their friends, and the husband never know it. In which sort he continueth foure and twentie hours long; but if they wash his feete with cold water hee presently reviveth and knoweth nothing thereof but thinketh

[2] For the synonomy of these two species see the author's Synopsis of the Genus Datura, in Journ. Wash. Acad. Sci. 11:—1921.

A SIXTEENTH CENTURY ILLUSTRATION OF DATURA

This is a reduced reproduction of Fuchsius's illustration figured in 1542 under the name "Stramonia," or Rauchaepffelkraut (*Datura metel* L). It was recognized by the botanists of that time as a solanaceous plant, but the genus Datura was established two centuries later by Linnaeus. (Fig. 11.).

VARIETIES OF DATURA METEL L

No. 1 is a typical, white-flowered single form often called D. *alba*, and No. 2 shows specimens of its dried fruit commonly used as a narcotic. No. 3 shows the form having double white corollas, usually called *D. fastuosa;* and No. 4 is the form with a double purple corolla. Both the white flowered and the colored varieties of *Datura metel* are used as intoxicants. (Fig. 12.)

he had slept." . . "This hearbe," he adds, "groweth in all places in abundance, and although it is forbidden to be gathered or once used, never-the-less those that are the principal forbidders of it are such as dayly eat thereof."

Christoval Acosta, in his Tractado de las Drogas y Medicinas de las Indias Orientales (1578) likens the trumpet-shaped flowers of this plant to those of a Convolvulus and its seeds to lentils. "Among the Hindu *enamoradas*," he says, "few are without Datura seeds among their most highly prized treasures." They were ground to a powder and administered in wine or some other medium as a love potion to the object of their affection; and, Acosta adds, "he who partakes of it is deprived of his reason (*queda enagenado*) for a long time laughing, or weeping, or sleeping, with various effects, and often times talking and replying, so that at times he appears to be in his right mind, but really being out of it, and not knowing the person to whom he is speaking, nor remembering what has happened after his alienation has passed. Many mundane ladies are such mistresses and adepts in the use of this seed, that they give it in doses corresponding to as many hours as they wish their poor victim to be unconscious or transported. And truly if I were to tell stories of what I have heard or seen relating to this matter, and the different ways I have seen people act when under the influence of the drug, I would cover many sheets of paper; but as this is not necessary I will refrain. I will only say that I have never seen any one die from its effects; and I have seen some who have gone about for several days perturbed, and this must have been because it had been given to them in too large doses, which if too great will cause death because this seed contains venomous parts, although the Gentiles administer it as a diuretic with pepper and betel leaves and say that it is efficacious; but this I have not seen nor tried, having other medicines more safe for the purpose."[3]

The high esteem with which this plant was regarded by the ancient Chinese is indicated by Li Shi-Chen, in his celebrated work on the Materia Medica of China, *Pen ts'ao kang mu*, published in 1590. According to this author the Chinese name of this plant, *man t'o lo hua* (probably derived from the Sanscrit) is taken from a famous Buddhist sutra, "Fa hua ching," in which it is stated that when Buddha preaches a sermon the heavens bedew the petals of this plant with rain-drops; and according to a more ancient tradition of the Taoists, the name of the plant is that of one of the circumpolar stars, and every envoy sent down from this star to the earth is supposed to carry in his hand one of its flowers; so that one of the Chinese came to call the flower by the name of the star. Li Shi-Chen gives a pretty good description of the plant, which he says has leaves resembling those of an egg-plant, flowers with a white hexagonal corolla, blooming in the eighth month (September) and round prickly fruits; but his description is corrected by a Japanese botanist, Ono Ranzan, who says that the flower is normally pentagonal instead of hexagonal, and this correction is sustained by Siinuma Yokusai, another authority on old Japanese botany, who gives a very good illustration of the flower in question (Fig. 12, No. 1) identifying it with the typical white-flowered form of *Datura metel*, which is known to the Japanese by the name *Chosen-asagao*, or "Korean Morning-glory."[4]

A synopsis of the genus Datura was published by the writer in the Journal of the Washington Academy of Sciences in order to clear up the existing confusion in its treatment by taxonomists and to straighten out conflicting statements as to the origin of some of the

[3] Acosta, Christoval. Tractado de las Drogas y medicinas de las Indias Orientales, p. 88. 1578.

[4] It is interesting to note in this place that *Datura stramonium*, our common Jamestown weed, which many botanists have supposed to be of Asiatic origin is called in Japan *yoshu Chosen-asagao*, *yoshu*, signifying "foreign."

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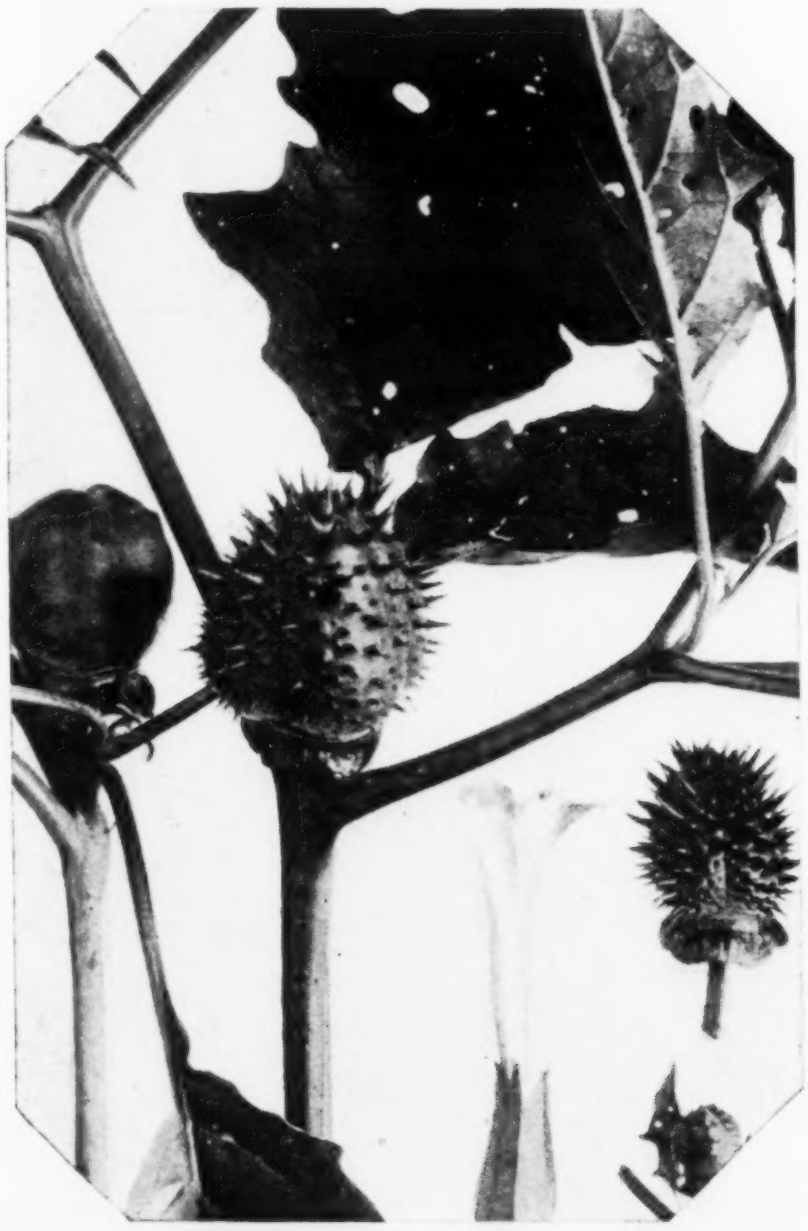


3 4

VARIETIES OF DATURA STRAMONIUM L.

No. 1 shows the leaves and fruit of the purple flowered form with armed capsules, usually called *D. tatula;* No. 2, leaves and fruit of the green-stemmed, white-flowered form with armed capsules, the typical form of the species; No. 3, purple flowered forms with armed and unarmed capsules; and No. 4, the white-flowered form with unarmed capsules, *Datura inermis* Jacq. These forms are admirably adapted as material for the study of heredity and mutations as they readily lend themselves to experiments in cross-pollination.

In one of the recent press dispatches sent by the leader of the Mount Everest Expedition, there was this description: "By the roadside were most marvelous hedges of daturas, 15 to 20 feet high, and covered with hundreds of enormous white trumpet-shaped blooms, each eight inches in diameter and fully 12 inches in length. At night they seem to gleam with a kind of phosphorescence emitting a strangely sweet scent." (Fig. 13.)

most common species.[5] An account of the ceremonial and medicinal uses of the various species in both the Old and the New World will appear in the forthcoming Annual Report of the Smithsonian Institution.

In recent years certain varieties of the Jamestown weed (*Datura stramonium*) have been used in the study of the phenomena of heredity and mutations. All of the species are admirably adapted for experiments in cross-pollination. The anthers of the flower chosen for the female parent can be removed easily before their dehiscence and the flower covered before the corolla unfolds. Pollen can be obtained with equal facility from the covered or unfolded flower chosen as the male parent and applied to the stigma of the emasculated flower. By this simple method white-flowered and purple forms, and forms with prickly and with smooth capsules can readily be crossed. Results of experiments of this nature made by Miss E. R. Saunders confirmed in a most striking manner the conclusions arrived at by Mendel relating to inheritance.[6]

In the summer of 1916 the writer collected specimens of purple flowered *Datura stramonium* growing at Round Hill, Virginia, some of which bore unarmed as well as prickly pods upon the same plant. A comparison of the former with specimens of the so-called *Datura inermis* showed them to be identical, while the prickley pods were like those of the purple-flowered *Datura tatula* and the white-flowered *Datura stramonium*.

In July 1916, seeds bearing the label "*Datura inermis*," received from F. A. Miller of the Eli Lilly Company, Indianapolis, were planted in the drug garden at Arlington by Dr. Stockberger of the Bureau of Plant Industry. Plants of four distinct forms were the result, all of which were collected and photographed by the writer. The most abundant, with reddish-purple stems, lavender-colored corollas, dark violet anthers, and upright, prickly capsules, was identical in appearance with the form commonly called *Datura tatula*. Next in abundance, occurring in about equal numbers, were white-flowered plants with prickly capsules like the typical *Datura stramonium* and lavender-colored plants with smooth, or unarmed, capsules; and least abundant of all was a form with white flowers and unarmed capsules, identical in all respects with *Datura inermis*. In Figure 13, No. 1 shows armed capsules of the purple-flowered form commonly called *Datura tatula:* No. 2, pods of the typical white-flowered *D. stramonium;* No. 3, armed and unarmed pods of of purple-stemmed, lavender-flowered plants; and No. 4 the green-stemmed, white-flowered form with unarmed capsules usually called *Datura inermis*.

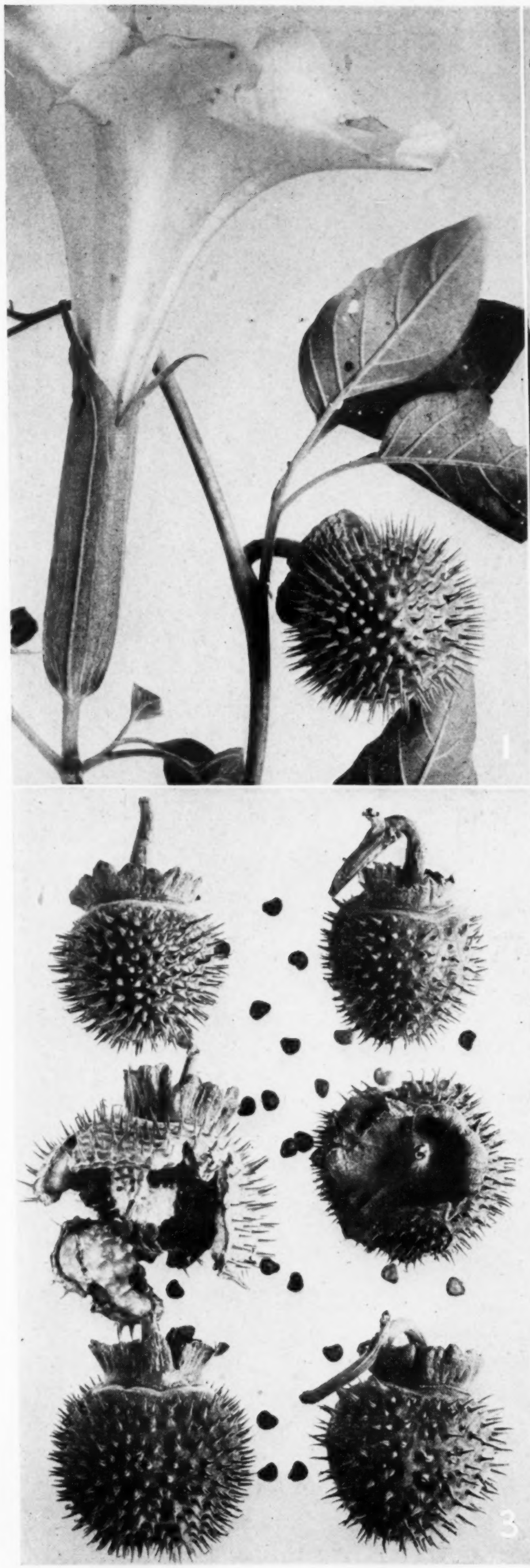
The evidence offered by the relative abundance of the various forms here shown corroborates the results of the experiments of Miss E. R. Saunders already referred to. Of the antagonistic color characters the violet was dominant and the white-flowered form recessive, and of the contrasted capsule forms the prickly one was dominant and the unarmed recessive.[7] Very similar results were presented in March 1917, by Blakeslee and Avery in the form of a living diagram showing the average results of a dihybrid cross between the purple-flowered, purple-stemmed *Datura stramonium tatula armata* (PAr) and the white-flowered, green-stemmed *Datura stramonium inermis* (WIn). In the latter case all the first generation hybrids had purple flowers and prickly pods, while in the second generation there were 9 purple armed, 3 white armed, and 3 purple unarmed, and 1 white unarmed, in perfect conformity with Mendel's law.[8]

[5] Safford, W. E., Synopsis of the Genus Datura. Journ. Wash. Acad. 11: 173–189, 1921.

[6] See Bateson, W., and Saunders, E. R., Experimental Studies in the Physiology of Heredity; in Reports of the Evolution Committee of the Royal Society of London 1:21, 1902.

[7] See Bateson, W., and Saunders, E. R., Experimental Studies in the Physiology of Heredity, in Reports of the Evolution Committee of the Royal Society of London 1:21. 1902.

[8] Blakeslee and Avery, Adzuki Beans and Jimson Weeds, in Journ. Hered. 8:125–131. 1917.



AN AMERICAN SPECIES, DATURA METELOIDES DUNAL

No. 1 shows a flower and fruit of this species, which occurs in two distinct color forms, one with white and the other with pale blue or lilac-colored corollas. No. 2 is a blue tinted flower grown at Arlington, Virginia. No. 3 shows some fruits of the blue and white flowered forms collected at Sacaton, Arizona; and No. 4 some immature fruits of the blue-tinted form grown at Arlington, showing expanded persistent bases of the calyces. (Fig. 14.)

In making their experiments Blakeslee and Avery encountered numerous mutations, chiefly in the relative length of the notes of the stem, and in the form of the leaves and capsules. Among the results of their observations was the discovery that the mutations were sudden, though of rare occurrence, and that they transmitted their characters —chiefly through the female sex— to only a part of their offspring.

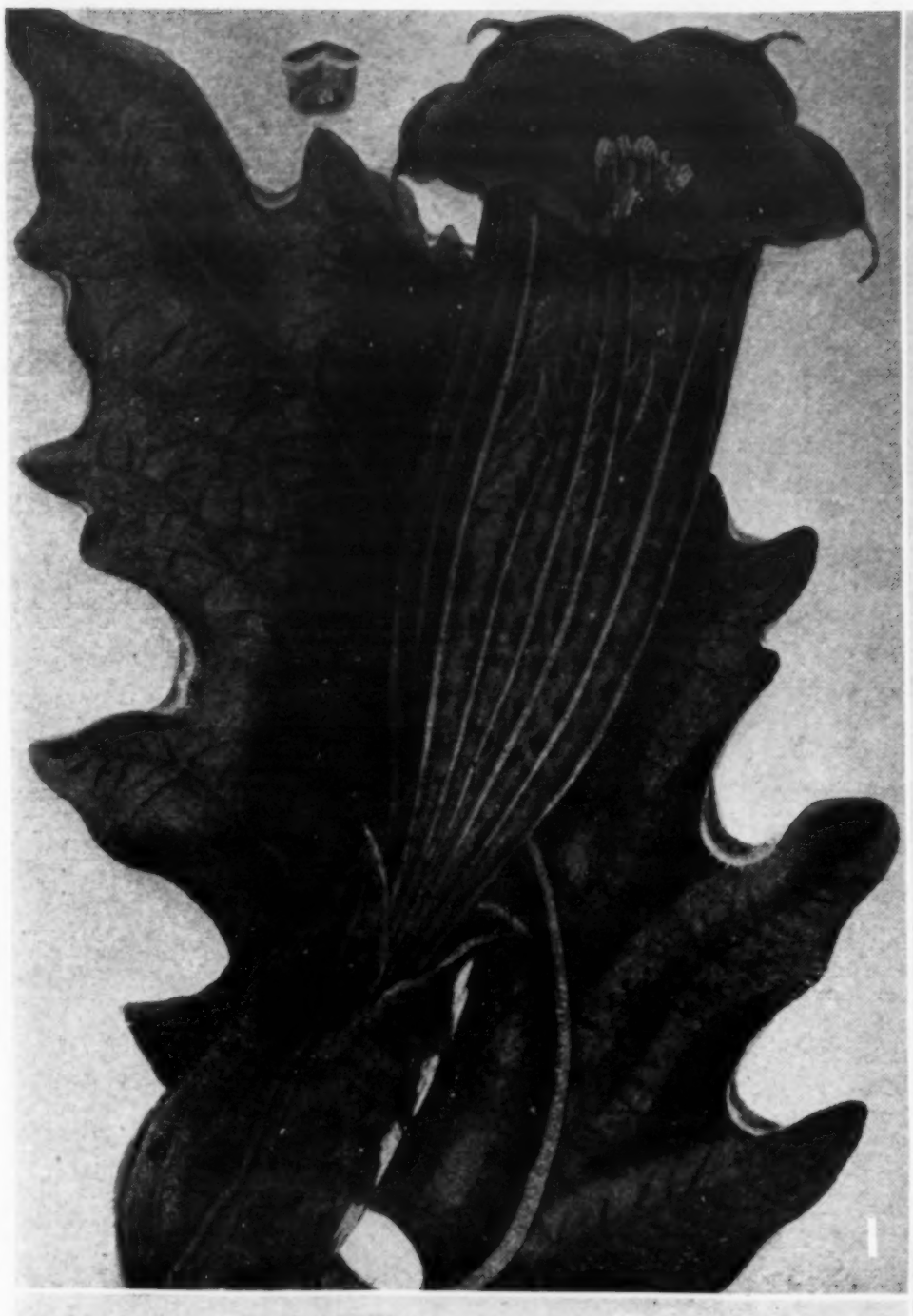
That the purple and white-flowered forms of *Datura stramonium* used in these experiments are specifically identical is certain. The statement has been repeatedly made that there is a difference in the relative length of the prickles arming the capsules of the two color forms, but in specimens collected by the writer no such difference could be detected. De Candolle in discussing the possibility of the separate origin of the two color-forms makes the following remarkable suggestion: "Si ces deux formes sont deux espèces, il est très possible que l'une fût de l'ancien et l'autre du nouveau monde, et alors je croirais le *Tatula* américain plutôt que l'autre." (If these two forms are two species, it is very possible that the one was of the Old World, and the other of the New, and then I should believe the Tatula is American rather than the other) After expressing his surprise that Humboldt and Bonpland had found *Datura tatula* to be common in the mountains of Caracas, he still clings to the possibility of its Old World origin, saying: "On indique peu de noms vulgaires pour ces Datura, et le plus souvent ceux usités par les crêoles sont dérivés des langues européens et trahissent une importation."[9] ("Only a few native names for Datura are given, and those most frequently used by the creoles are derived from European languages and betray their importation.") As a matter of fact both the white-flowered *Datura stramonium* and the purple-flowered *D. tatula* are found growing spontaneously in many parts of North, Central, and South America. The latter, which as already stated, is the dominant form is naturally most common. De Candolle regretted the absence of vernacular names for them, which he recognized as important in indicating whether they were endemic or imported. Fortunately we have vernacular names for the very species in question. The Aztec name *tlapatl* still survives in Mexico and is applied to both the white-flowered and purple-flowered forms, sometimes modified to the forms *tlapá* or *tapatl*. Professor Pittier records it from Salvador under the form *tapá*. There is no possibility that these names are of European origin, introduced by the creoles. In addition to them there are creole names, it is true, such as the significant "vuelve-te-loco" in Guatemala. That the recessive white-flowered form should be "naturalized . . . probably from Asia" and the dominant purple-flowered form, so closely allied to it as to be indistinguishable except by the color of its stem and flowers, should be "naturalized from tropical America" is unthinkable; and there is no valid reason for questioning Linnaeus, who, in establishing the species *Datura stramonium*, adds to his brief description: "*Habitat in America, nunc vulgaris per Europam.*"

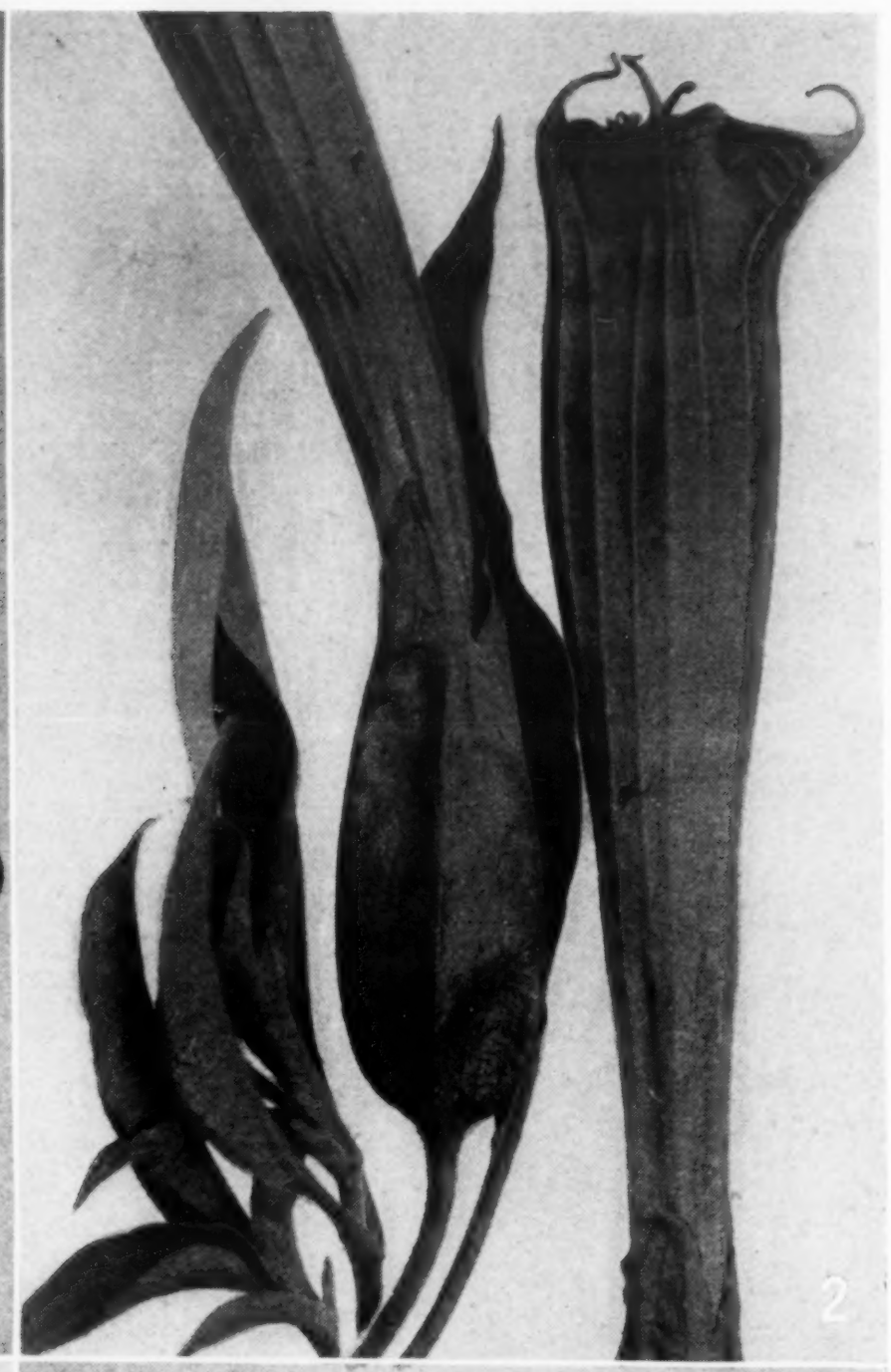
Datura stramonium played an important part in the religious rituals of certain aboriginal tribes of Eastern North America, who used it in the ceremonial called *huskanawing*, in which boys arriving at the age of puberty were initiated into the status of manhood.[10] It takes its common name Jamestown Weed (now modified to "jimson weed") from its effect upon soldiers sent in 1676 to Jamestown to quell the uprising known as Bacon's Rebellion. The behavior of the soldiers while under its influence, as described by Beverley, recalls the intoxicating effects of the Asiatic *Datura metel* mentioned by the writers already cited.[11]

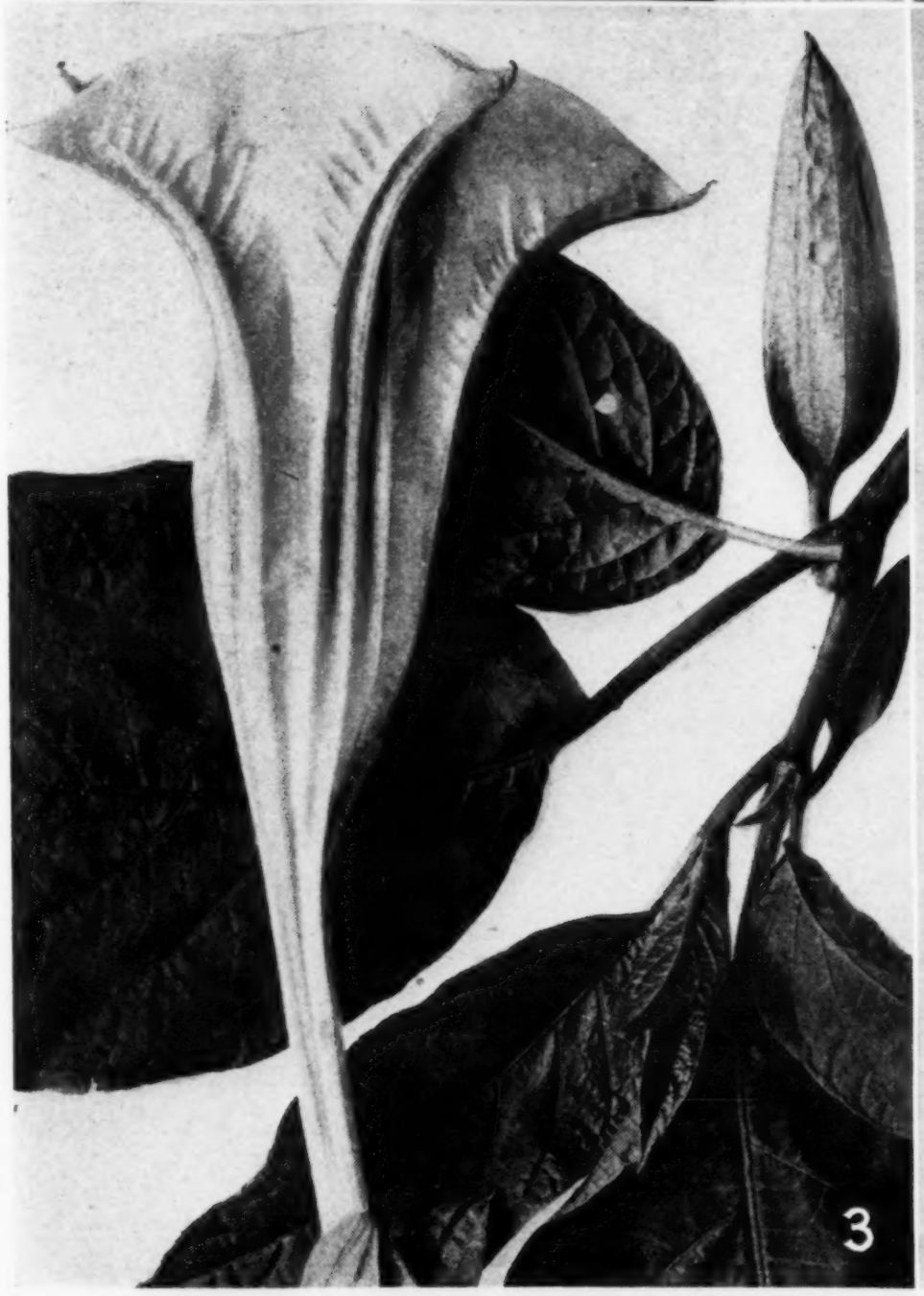
[9] De Candolle, Alphonse. Géographie Botanique, 2:773. 1855.

[10] Beverley, Hist. Virginia book 3:32, 39. 1705.

[11] Beverley, Hist. Virginia book 2:24. 1705. Safford, in Annual Report Smithsonian Institution for 1916:408. 1917.







FLOWERS OF TREE-DATURAS OF SOUTH AMERICA

No. 4 is the *Datura arborea* L. variety with remotely toothed leaves and flowers larger than the type collected in the Peruvian Andes; No. 3, *Datura suaveolens* H. & B. with inflated calyx, toothed at tip, and coherent anthers, photographed from a cultivated specimen; No. 2, *Datura sanguinea* R. & P. with glabrous orange and scarlet flowers and narrow, entire leaves; No. 1, *D. Rosei Safford* with pubescent saffron-colored flowers and sinuate velvety leaves. (Fig. 15.)

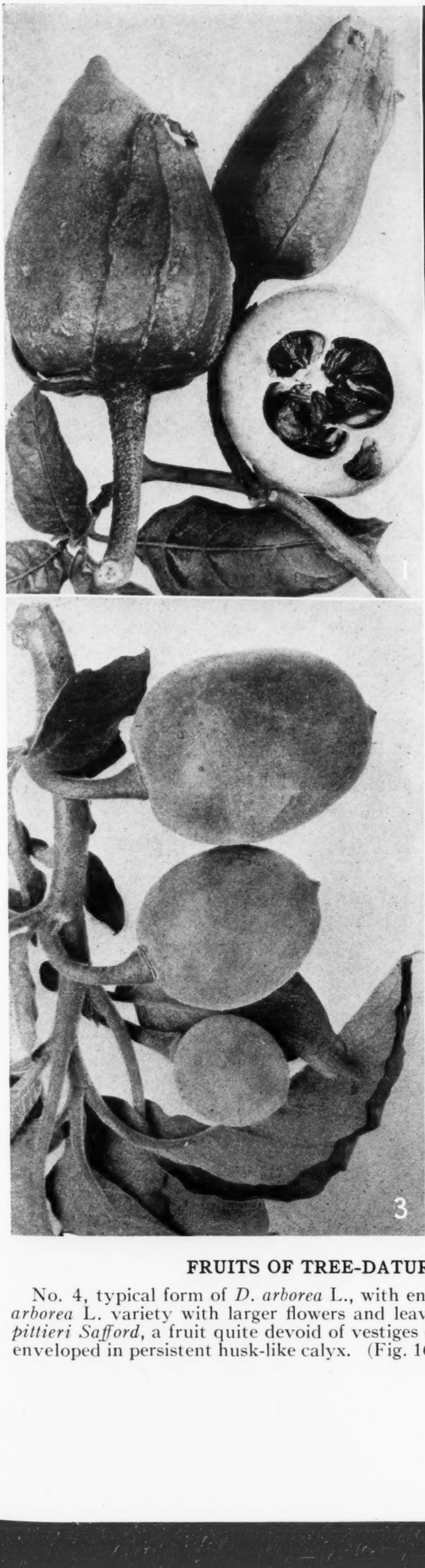
Thus far experiments in cross-breeding Daturas have been confined to forms of *Datura stramonium*. Other species of this genus occur in marked color forms. They vary in the armature of their fruits and are equally inviting for study, especially the Asiatic *Datura metel* above described. The latter has still another interesting form-variation: its corollas as already stated, are sometimes simple and sometimes double. Simple and double flowers of the purple-flowered form, usually called *D. fastuosa*, were collected by the writer from a single plant in the garden of Mrs. Augustus Saint Gaudens, at Coconut Grove, Florida. Simple and double flowers are also encountered in other sections of the genus, including the Brugmansias or tree-daturas of South America.

Datura meteloides, an American species used ceremonially by the Mexicans, Zuñis, and California Indians, occurs in two marked color forms, one with white and the other with pale blue or lilac-colored corollas. In Figure 14 these forms are shown together with their characteristic nodding pods subtended by an expansion of the persistent base of the circumscissile calyx. Very closely allied to this species is the "Downy Thorn-Apple" (*Datura innoxia* Miller) already referred to, an American plant often confused with *D. metel* L., but differing from that species in its downy indument and its 10-toothed instead of 5-toothed corolla.[12] Another form closely related to *D. meteloides* and still more closely to *D. innoxia*, is *D. discolor*, also with nodding fruit and a 10-toothed corolla, but easily distinguished from both of its allies by its black seeds. The narcotic plant called *Ololiuhqui* by the Aztecs was undoubtedly a Datura of this section, although it has been erroneously described as a species of Convolvulus, or Ipomoea. Hernandez, in describing it, uses nearly the same expressions as Acosta when he speaks of *Datura metel*, comparing its trumpet-shaped flower to that of a Convolvulus and its seeds to lentils.

All the Daturas thus far described produce an abundance of seeds. Few of the tree-daturas, or Brugmansias of South America, on the other hand, are known to be fertile in cultivation. They therefore present greater difficulties as material for the study of heredity. It is quite possible that in their native habitats they are pollinated by long-billed humming birds, and those that bloom in the evening and are fragrant during the night may like other Solanaceae, attract nocturnal moths allied to the Sphingidae with proboscids long enough to reach the nectar at the base of the filaments. Lagerheim noticed that certain species growing in Ecuador are cross-pollinated by a humming-bird belonging to the genus Docimastes having a bill 12 cm. long. This bird visits the long pendulous blossoms apparently in quest of small insects as well as of nectar. Shorter-billed species rupture the corolla tubes from without. The flowers of the tree-daturas vary greatly in color as well as in the form of the calyx. The latter in some species is spathe-like and pointed, in others notched or toothed at the apex. It would be of great interest to cross-pollinate the white-flowered *Datura arborea* with the recently described red-flowered *D. rubella* which closely resembles it in form; and the orange-flowered *D. aurea* or the delicate pink *D. mollis* with the white-flowered *D. candida*. Crosses might also be made between the Brazilian *D. suaveolens*, which has coherent anthers, a 5-toothed inflated calyx and slender fusiform fruit with other species having distinct anthers, spathe-like acuminate calyces, and spheroid or oval fruits. It would be equally interesting to observe the effects of crossing *Datura sanguinea* or *D. rosei*, species with the fruit enveloped in a persistent husk-like calyx, with other species like *D. pittieri*, in which the calyx is quite deciduous.

Figure 15 shows the flowers of four

[12] Typical specimens of *Datura innoxia* Miller, called by the Aztecs Nacazcul, or Toloatzin, were collected by Dr. Edward Palmer in 1898 in the vicinity of San Luis Potosi, Mexico (No. 677).



FRUITS OF TREE-DATURAS OF SOUTH AMERICA

No. 4, typical form of *D. arborea* L., with entire leaves, and spheroid fruit; No. 3, the *Datura arborea* L. variety with larger flowers and leaves remotely toothed instead of entire; No. 2 D. *pittieri Safford*, a fruit quite devoid of vestiges of the calyx; No. 1, *D. sanguinea* R. & P. a fruit enveloped in persistent husk-like calyx. (Fig. 16.)

contrasted species of the section Brugmansia, or tree daturas: *Datura arborea*, *D. suaveolens*, *D. sanguinea*, and *D. rosei*. Figure 16 shows fruits of plants belonging to the same section: No. 1 of the typical form of *D. arborea*, with entire leaves collected by Mr. O. F. Cook in the Andes of Peru; No. 2, of a second form of the same species with remotely toothed leaves and somewhat larger flowers; No. 3, of *Datura sanguinea* with narrow entire leaves and glabrous red flowers; and No. 4, of *D. rosei* a closely allied species with sinuate or lobed velvet leaves, and pubescent saffron-colored flowers with tomentose peduncles.

Tree daturas are usually propagated by means of cuttings. It is quite possible, however, to obtain seeds of most of them in their natural habitats, and by crossing their progeny developed varieties rivaling the hybrid Cannas, Begonias and other beautiful creations of recent years.

EDUCATION AND THE SIZE OF FAMILIES

Worcester, Mass.

The Editor,
JOURNAL OF HEREDITY,
Washington, D.C.

Dear Sir:

There have been a number of investigations as to the size of families of college graduates, compared to nongraduates, the universal conclusion being that the college graduates do not produce enough children to maintain their numbers. Further figures show that the graduates of women's colleges produce but little more than half as many children as those from coeducational colleges, largely because a smaller proportion of the former marry. These facts are well enough established so that it is not necessary to quote figures, but the interpretation of these figures is a subject that badly needs study.

Some investigators look at the small number of children in the families of the women graduates, and jump to the conclusion that they have located the trouble, but the records of women in the same class of society, who do not attend college, show a similar condition. There may be a fault here—there very likely is—but for the principal causes we must look further.

FAMILIES OF SCIENTIFIC MEN

Cattell, in the Scientific Monthly, Vol. 4, page 248, has given some interesting data on this subject in an article about the families of scientific men. This data is especially valuable as it was collected without any reference to the theory that I am supporting. He shows that while early marriages, in general, produce larger families, in the case of scientific men those who marry between the ages of 25 and 30 have the largest families. He further shows that the educated wife of a scientific man has nearly if not quite as large a family as the uneducated wife.

These two facts have received but little consideration, but are extremely significant. Further investigation should be undertaken in other groups of society along similar lines, such as among the doctors, ministers, laborers, etc. It would also be interesting to see if the same results are to be found among the unsuccessful scientific men, for Cattell only considered the successful ones. Possibly the relationship of early marriage and large families is not one of cause and effect, but is only a common characteristic of the same classes in society, and that if we could postpone the marriage of the feeble minded they would have even larger families. But this does not seem probable. It is more likely that this is confined to certain classes. To which classes is it confined and for what causes?

ECONOMIC REASONS FOR SMALL FAMILIES

Scientific men have a conspicuously small income when young. Given a wife to support, together with a strong interest in science to engage his attention, what is more natural than that the financial needs should tend toward a limitation in the size of the family; and if limitation is well established for a period of years, what is more natural than that it should continue regardless of future conditions. I have no evidence that such is the case, and proof would be difficult to obtain, but the probabilities point to such a conclusion.

Financial needs are a variable, depending upon the standard of living. The problem is then to make the income, the standard of living, and the age of marriage meet at a common point, as early in life as possible. All three variables are difficult to change, but our educational institutions have a great effect on all people.

The standard of living depends largely on the incomes of the parents and friends of the individual, and also on the wife's surroundings. The desired result can be obtained by reducing the standard of living, which means reducing the incomes of the older members of society. A high standard of living is desirable, but one higher than necessary for physical and intellectual health is injurious if it interferes with the production of children of the best inheritance for the coming generation.

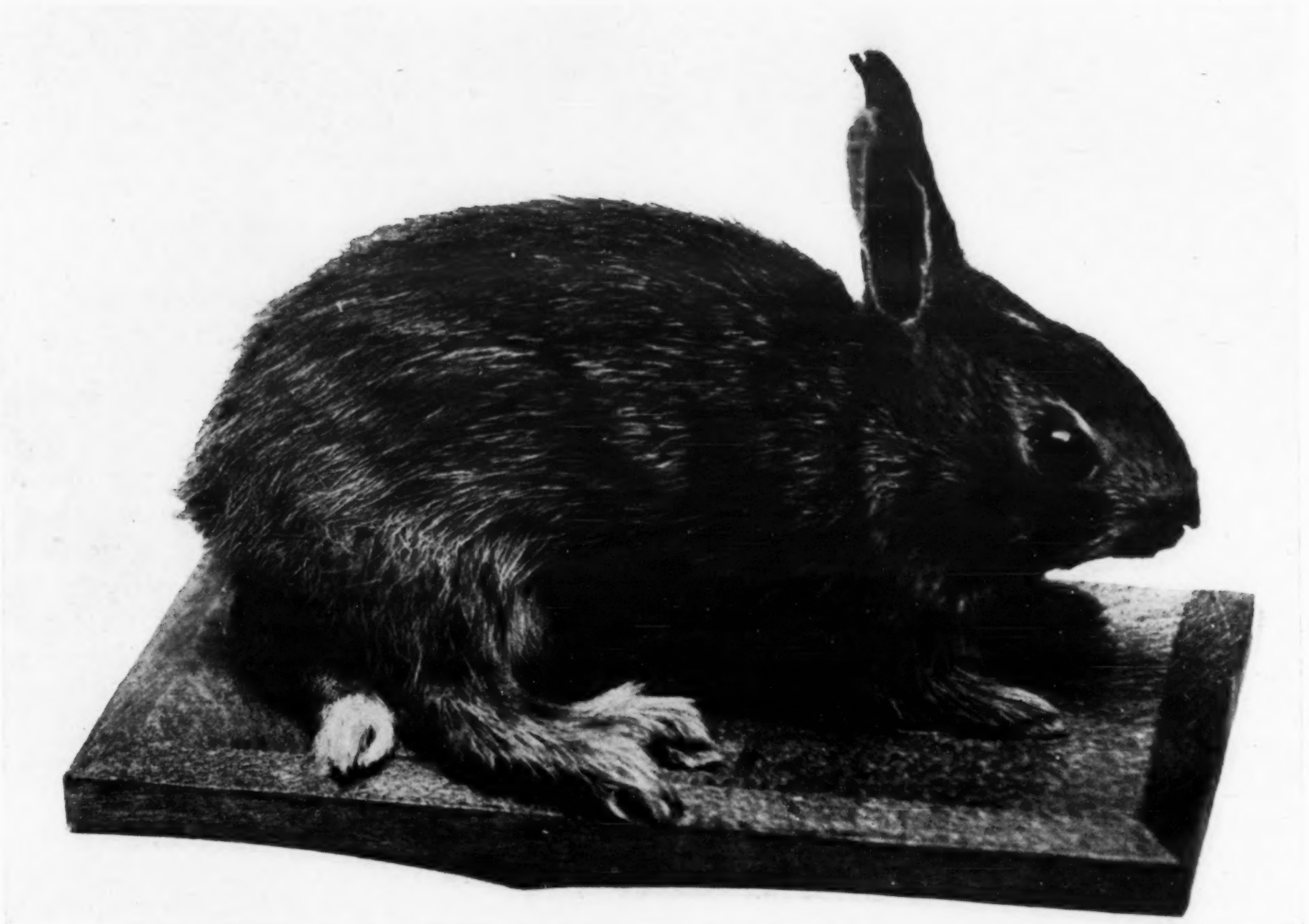
The colleges claim that they increase the income of the older persons. That is to say, in addition to cultural benefits, the colleges also give financial benefits, but that these benefits are not seen until late in life. It is evident to all that the colleges decrease the income of young people below the age of 25 or 30 or possibly higher. We therefore have a double charge against the college, based on its own claims. It puts two obstacles in the way of the families of their graduates—a small income when a large one is most needed, and a large one when it can only be an injury eugenically. Some of us question the claim that the colleges increase the incomes of their graduates at any time of life.

The proposition that I wish to make is that the condition most favorable to large families is an income of the sons equal to that of the parents at as early an age as possible. I cannot see how the education of the wife is an important factor. At present this condition is met among those of inferior parents, and therefore of probably inferior inheritance, and among the foreign families where the parents have been kept back by ignorance of our customs. It is farthest from being true among those with the best inheritance, and the colleges are largely responsible for the condition. From the point of view of eugenics, therefore, is not college training one of the greatest menaces to our civilization?

Very truly yours,
A. W. FORBES

CONSPICUOUS VALUE OF PUREBREDS

The value of purebred live stock, say specialists in the United States Department of Agriculture, is most noticeable in those cases in which the capability of the animals is measured most directly. Among farm animals the best illustration can be found in dairy cattle, though careful yearly tests of milk and butterfat production are relatively recent affairs. The enormous differences among dairy cows when given the same opportunity have been brought out clearly in a great number of cases, and these differences are strongly inherited through both the sire and the dam. The average production for purebreds and grades is much above the average of all milk cows, which is about 4,000 pounds of milk and 160 pounds of butterfat annually. —*Weekly News Letter, U. S. Department of Agriculture.*



A RABBIT WITH FIVE LEGS AND SIX FEET

Through the kindness of Mr. B. J. Livermore of Newark Valley, N. Y.,. I am permitted to report an interesting anomaly belonging to his collection. The rabbit shown in the photograph was captured when not more than three or four weeks old, and sent to Mr. Livermore who prepared its skin. There were several other young rabbits in the litter, all of them normal. There was an extra right hind leg, while the one in the normal position had a bifid foot. In view of the nature of the deformity it is unfortunate that it was not possible to determine its transmissibility. —Dr. F. E. Chidester, Department of Zoology, West Virginia University. (Fig. 17.)

THE DAWN OF EUGENICS

A farmer showed me a calf, and the point of his hopes and ambitions concerning it centered more in its parents than the little, milky-nosed creature itself. He spoke with enthusiasm of its dam's varied virtues and its sire's bovine grandeur of girth and constitution, hoping that the little bull would develop these good points and better his havage in his progeny.

Why do we not love our unborn as well as stockraisers and those who labour at new onions and potatoes? Surely the child is as important as the horse he will ride, or the beef and vegetables he will consume.

Let our hearts grow a little hotter for the boys and girls to be; let them share our dreams with the sheep and the sweet-pea of the future. Let us think upon them oftener, that when they come we can trust them to be wiser than ourselves; that when they have donned their flesh and we have doffed our own, they may look back and know that, despite our limitations, we loved them. The foreglow of such a hope is upon the horizon, but, curiously enough, the religious resent it. Yet eugenics must brighten into a good dawn presently.[1]

No doubt there are some people who believe that all marriages are made in heaven, so that human judgment is excluded, but few people who face this question at all will deny the need of higher standards of responsibility in relation to marriage. Will any deny the right of the child to be born of normal, healthy parents, or the right of young men and women to avoid disease, deformity, or hereditary defects, so that they may look forward to normal, healthy children?

[1] Eden Phillpotts—A Shadow Passes.